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MAY 1945

PUBLISHED MONTHLY BY AMERICAN MEDICAL ASSOCIATION, 535 NORTH DEARBORN STREET, CHICAGO 10, ILLINOIS. ANNUAL SUBSCRIPTION, $6.00

Entered as Second Class Matter Jan. 14, 1925, at the Postoffice at Chicago, Under the Act of Congress of March 3, 1879

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THE PROBLEM OF AVIATION DEAFNESS

THE AIRMAN, HIS HISTORY AND HIS PLANE

COLONEL PAUL A. CAMPBELL

MEDICAL CORPS, ARMY OF THE UNITED STATES

he staff of the Research Laboratory of the y Air Forces School of Aviation Medicine, dolph Field, Texas, has for some time at- pted to carry on a running survey of sam- of flying personnel in order to appraise sical changes which might be due to flight. ee ends may be achieved: First, preventive sures which may become necessary can be in- ted early; second, those in authority can be constantly informed of the physical status he Air Force personnel, and third, plans can made for the care and rehabilitation of those whom some form of physical defect may de- p as a result of their service with the Army Forces.

he department of otolaryngology of the Re- rch Laboratory of the School of Aviation dicine has been particularly interested in ching for trends which might point toward airment of hearing in those taking part in ial flight. In these articles Lieutenant Colonel s, Captain Senturia and I will attempt to pre- t a picture of the hearing situation in the Army Forces as we see it today.

irst of all, I shall briefly attempt to describe various general conditions and situations with ich we deal. Lieutenant Colonel Kos will then cuss the effects of changes in barometric pres- e on hearing, and Captain Senturia will de- ibe the effects of noise on hearing. Then I ll attempt to summarize the trends as they are orted from the field today.

t has long been known that certain aspects of ht may affect hearing under certain condi- ns.[1] It has also been known, however, that those o fly must first of all be considered as a part the general population, subject to the same tors which may cause auditory impairment in other portion of that population. Thus the evaluation of the hearing loss of any flyer must take into consideration the following factors:

1. The hearing apparatus which the aviator inherited, or shall I say, with which he was born.
2. His physiologic age.
3. The noise to which he has been subjected during his previous life.
4. The ability of his tubal-tympanic apparatus to equalize the changes in barometric pressure to which he has been subjected.
5. Past diseases of his ears.
6. Diseases, other than those of the ears, past or present—especially those which produce toxins, either endogenous or exogenous.
7. The effects of anoxia.

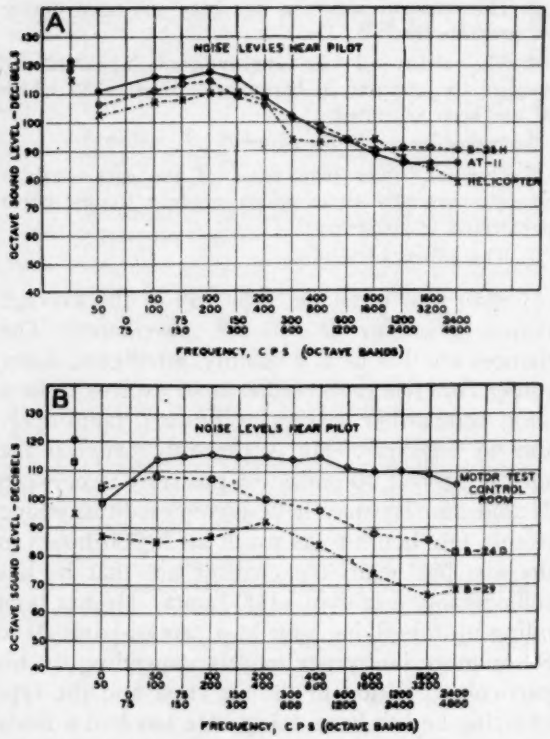
I shall now construct a picture of the average airman whom we have under surveillance. The chances are that he is a healthy, intelligent, eager young American who either is or aspires to be a pilot, bombardier, navigator, gunner, radio operator or engineer. He is probably between the ages of 18 and 40 and most probably is between 21 and 25. He may have to his credit anything from a few hours to as much as 20,000 hours in the air, but again the chances are that he has considerably less than 1,000 hours. He has been piling up this flying time at a rate of from 20 to 80 or more hours per month, depending on his particular position in the air crew and the type of flying he has been doing. He has had a fairly normal infancy, childhood and young adult life, probably a little on the rugged side. He has had the usual childhood diseases and may or may not have had his tonsils and adenoids out. He, like any other American boy, has probably undergone a certain amount of noise trauma during his life, from firecrackers, shotguns, occupational procedures, and so on. If he lived in the South, he may have had quinine in any of the various forms used in antimalarial and other forms of therapy, prophylactic or active. He possibly has consumed a certain amount of alcohol and tobacco. However, at the time he came into the Air Forces he was in good health and physically fit. From the standpoint of his ears, his tympanic membranes were free of perforation or other gross abnormali-

This and the two articles that follow, by Lieutenant lonel C. M. Kos and Captain Ben H. Senturia, were sented as a Symposium on the Present Status of the blem of Aviation Deafness at the meeting of the erican Academy of Ophthalmology and Otolaryn- gy in Chicago, Oct. 8, 1944.

Campbell, P. A.: The Effect of Flight upon Hear- , J. Aviation Med. **13**:56 (March) 1942.

ties. His eustachian tubes were considered by his examiner to function within normal limits. He was probably able to hear a whispered voice (whose voice we cannot say) in favorable (?) surroundings from a distance of 20 feet (6 meters). However, regulations as dictated by the manpower requirements did at times cause a degree of relaxation of this particular requirement, especially if it affected trained personnel.

After his selection for the Army Air Forces, this composite person was given medical care and physical conditioning equal to or better than he had had in his previous life. His diet was probably more carefully selected than at any time since infancy.



A, noise levels near the pilot in a B-25 H bomber, an AT-11 training plane and a helicopter. *B*, noise levels near the pilot in a motor test control room, a B-24 D bomber and a B-29 bomber.

After his preliminary ground training, he began to take part in aerial flights. The type of aircraft in which he flew, and his position in that aircraft, varied with the particular job which he did or for which he was being prepared.

Now to turn to the aircraft in which he flew. This machine possibly varied from the primary trainer of very low power to the B-29 superfortress with four 2,200 horsepower motors. The noise to which he may have been exposed at some time or other is shown graphically in the accompanying chart.

Some time during or after his training began to shoot. The guns included the 12 g shotgun, the usual small arms, 30 and 50 cal machine guns and possibly armament as larg aircraft-mounted 37 mm. and 75 mm. can He may have been taught to bomb, but in most stances the explosions of the bombs were so away that they probably had little if any ef on his auditory mechanisms. The amount the type of trauma which he possibly recei from firearms again varied with his partic aircrew duty or position.

During his training he learned to use airc communication systems. If he was to becom pilot, co-pilot, radio operator or navigator, hypothetic person must have spent a certain p tion of his flying hours exposed to the 1,000 c airways beam, tuned up loud enough so that could distinguish between the dot-dashes of "a's" and the dash-dots of the "n's," which note the different sides of the beams. At ti his well-being may have depended on his abi to distinguish such words as "northeast" "northwest" through a blanket of radio sta Thus his signals must have been tuned up h enough to be intelligible. This at times undou edly necessitated a level of static approach the threshold of pain.

After finishing his training, he went into ope tional flying, which may have included com of various sorts, in various parts of the wo His life under these conditions was much m rugged than it had been in the past, but for most part the conditions which may have affec his hearing were not much more unfavorable th those which he had experienced during traini

This composite airman of whom I have b speaking has received a certain degree of prot tion from noise trauma. First of all, in contr to his predecessor of World War I, he has p formed most of his flying inside an inclosed co pit, cabin or turret. In the more recent aircraft has had the advantage of some sound conditi ing. One may note in chart *B* that the no levels in the new B-29, even though that is most powerful aircraft of any in use today, within the comfort range.

The airman has also had a certain amount protection afforded by cotton pledgets placed his external auditory canals or by other devic provided he chose to wear them. During portio of his training, especially during his high altitu and combat flights, he must have received a c tain degree of protection from his helmet and radio communications headset. The various p tection devices which have been devised for t ears to keep out ambient noise have not been

ch aid, as until recently none have been de-
d which would permit sufficient air to flow
ough them during ascent and descent to equal-
the barometric pressure inside the external
als with that outside.

During his training he has also undergone
nges in barometric pressure which both in
ree and rapidity were of much greater magni-
e than those to which he was subjected in his
flying environment.

MMARY BY COLONEL PAUL A. CAMPBELL OF PAPERS BY LIEUTENANT COLONEL KOS AND CAPTAIN SENTURIA

Both Lieutenant Colonel Kos and Captain Sen-
ia have presented an objective picture of what
happen to the acoustic apparatus in airmen.
w I shall turn to that which has happened. We
e been in more or less constant touch with the
d, the redistribution centers, and the con-
escent centers, relative to the magnitude of
s problem. From each installation we con-
ntly get the same reply to our inquiries. That
ly is that the hearing loss in Air Force per-
nnel which could be attributed to flight is a
nor problem.

How can we account for this discrepancy be-
een that which can happen and that which
parently has happened? First of all, as has
en emphasized, both the effect of noise and the
fect of change in barometric pressure are for
e most part reversible. There has been plenty
noise and there has been plenty of aero-otitis media, but in well selected healthy young people whose insults have not been too great there is a great tendency for recovery, and recovery is the rule.

In the second place, there is undoubtedly great individual variation in the vulnerability of the acoustic apparatus to those conditions produced by flight. The portion of the population extremely vulnerable to noise is certainly not great.

Dips and notches undoubtedly can be found in the audiograms of a certain percentage of the personnel who have been exposed to high levels of noise. However, these dips and notches are for the most part above the conversational range and therefore do not produce subjective loss. In many cases the loss is a greater source of interest to the audiometrist than to the subject.

It may be said at this point that hearing loss produced by anoxia has offered no problem. In the first place, the auditory mechanism is extremely resistant to anoxia, and in the second place, there is no reason for anoxia to exist, as there is a most efficient prophylactic, namely, supplementary oxygen. Every airman has his own oxygen supply, and every airman knows how to use it.

We are indeed pleased to be able to report that at this time at least deafness in airmen has been no appreciable problem. It augurs well that the methods of selection, care and protection of Air Force personnel have achieved their purpose, but most of all, it points to the fact that the American youngster is able to take it.

EFFECT OF BAROMETRIC PRESSURE CHANGES ON HEARING

LIEUTENANT COLONEL C. M. KOS
MEDICAL CORPS, ARMY OF THE UNITED STATES

A little more than one hundred years ago an aeronaut complained of loss of hearing following a descent from 29,000 feet (8,839 meters) in a balloon.[1] His disability must have been considered trivial to inspire so few words in the historical record. Today this condition, associated with aero-otitis media,[2] is the subject of widespread interest, challenging the attention of every one seeking to reduce its incidence.

The traumatizing barometric pressure changes occurring in the middle ear during descent in flight must be classified among the influences which may impair hearing. Variations of pressure produced in the middle ear during ascent and descent exert only fleeting changes in hearing when prompt intermittent compensation is successfully affected by adequately functioning eustachian tubes. Personnel who have been trained in the technic of ventilating their middle ears undergo literally hundreds of such pressure cycles with practically no known ill effects. The transitory subjective fading of sound may be annoying but only momentarily obstructive to exact auditory reception.

It is only when these pressure changes in the middle ear are inhibited or prevented by restrictions on the permeability of the eustachian tubes that injury of tympanic tissue results. The symptom most consistently associated with this condition is an obstructive impairment of hearing which has been called "aviation pressure deafness" (Royal Air Force). The term must be severed from its subtle fringes of meaning, for it is often confused with aero-otitis media or otitic barotrauma. When the use of the expression "aviation pressure deafness" is restricted by precise definition, it refers to the deafness resulting from aero-otitis media.

Aviation pressure deafness is for the most temporary, and when uncomplicated it ra becomes progressive or permanent even if th peutically neglected. In a few cases, howeve may become recalcitrant or persistent and requires intensive treatment.

The inequality of pressure between the t panic cavity and the atmospheric environment poses a restriction on the free movements of mechanism of transmission in the middle ear the intratympanic pressure is relatively nega to an excessive degree, it may subject the tissues to a variable degree of transvascular f resulting in edema and effusion. These eff are induced by partial or complete obstructio the eustachian tube and are made manifest by increased tension of the membrana tympani, interference with movements of the ossic chain and (*c*) alteration of the contained mas density of the middle ear cavity and of the jacent cellular development.[3] The extent to wh each of these manifestations of tubal obstruc contributes to depression of hearing is not ea determined.

Clinically, it is difficult to evaluate the fluence of the retracted drum membrane respect to the action of the ossicular lever its effect on the severity and the e. tent of d ness. In most instances the function of depends on the other. However, on the hand, a flaccid drum membrane may be marke retracted without appreciably limiting the movement of the ossicles or resulting in nificant impairment of hearing. On the ot hand, the normally tense membrane, slig retracted, may jam the ossicles to such an ex that deafness becomes a serious sequela. I quite obvious that the degree of retraction is a reliable indication of ossicular splinting that its effect may be judged only by measur the amount of conduction deafness.

This article, the one by Colonel Campbell which precedes it and that by Captain Senturia which follows it were presented as a Symposium on the Present Status of the Problem of Aviation Deafness at the meeting of the American Academy of Ophthalmology and Otolaryngology in Chicago, Oct. 8, 1944.

1. Bert, P.: Barometric Pressure, translated by M. A. Hitchcock and F. A. Hitchcock, Columbus, Ohio, College Book Company, 1943.

2. Armstrong, H. G.: Principles and Practice of Aviation Medicine, Baltimore, Williams & Wilkins Company, 1939.

3. (*a*) Wever, E. G.; Bray, C. W., and Lawre M.: The Effects of Pressure in the Middle Ear, Exper. Psychol. **30**:40 (Jan.) 1942. (*b*) Loch, W. Effect of Experimentally Altered Pressure in Middle Ear on Hearing Acuity in Man, Ann. O Rhin. & Laryng. **51**:995 (Dec.) 1942. (*c*) Stev S. S., and Davis, H.: Hearing: Its Psychology Physiology, New York, John Wiley & Sons, Inc., 1

In addition to these mechanical alterations, the ss of the middle ear system may be so in- eased as a consequence of edema and sero- nguineous transudation as to cause a damping sound transmission. One cannot be dogmatic out the degree and the type of hearing loss to expected from any particular abnormality in e drum or the mucous membrane. Con- derable interstitial injury, depending on the act details of the physical changes which have curred, may exist without significant auditory terioration.

When all these factors responsible for limit- g function of the middle ear are present in com- nation, their separate effects may contribute to serious impairment of hearing, or each may pose the other to mitigate the severity of the afness. This is demonstrated when there is esent in the hypotympanum a small amount of id, which partially neutralizes marked negative essure. The fluid does not add appreciably the natural impedance of the conduction sys- m. The compensatory effect of effusion in the iddle ear and its relation to reversal of a aring loss is not often stressed.

On the presumption that diversity of opinion ises because of inherent variables in testing and aluating, the auditory effect of relative negative essure on the medial side of the tympanic embrane was determined principally by two ethods: The first is dependent on the evidence tained by a series of successive post-traumatic diograms, with the assumption that the pre- aumatic threshold is equivalent to the level at hich hearing ceases to improve. It is realized at the results are open to question and possibly ay lead to fallacious conclusions, particularly hen the status of the subject's actual normal aring is doubtful.

The second and more exact approach to the oblem provides valid information. It con- sts in a comparison of pretraumatic and post- aumatic audiograms. In this comparison one ay determine precisely the consequences of auma ex vacuo within the tubal lumen and mpanic cavity.

Fifty-four persons (108 ears) were studied nder circumstances which permitted the appli- ation of one or both of the technics mentioned. en on whom preexposure audiograms were tained descended from 38,000 feet (11,582 eters) in the pressure chamber and involuntarily curred trauma of the middle ear beginning at n altitude approximating 12,000 feet (3,657 eters). The objective injury was variable as ould be expected among a group of persons ossessing normal physical dissimilarities. oreover, many of these subjects succeeded in estoring the patency of their eustachian tubes by means of the Valsalva procedure before reaching ground level.

Five subjects descended from 7,000 feet (2,133 meters) making no attempt to prevent tubal obstruction. Unintentional but compelled acts of swallowing released the compression of the tubes in 2 following the return to ground level. The damage, however, had been done, and the fortuitous opening of the tube merely served to mitigate the dynamic forces contributing to the injury.

The remaining 39 subjects were unselected in the sense that there was no opportunity to secure preexposure audiograms and also because they were referred from other sources. All of them stated that their trouble began at an altitude of not less than 5,000 feet (1,524 meters). Most of these men were examined within a few minutes after their injury and were observed continuously or periodically until the hearing returned to approximately normal levels.

Among this group of 54 men 40 sustained injury of both middle ears, while only 14 experienced unilateral injury. Thus the ears involved numbered 94 of the total of 108. Usually the distribution of bilateral and unilateral otitic barotrauma is about equal. It would be expected that those with bilateral otitic lesions were more aware of their disability than were those with unilateral lesions. The apparent vascular and mucosal damage of the middle ear reflected by the appearance of the drum membrane did not always indicate the degree or the type of the hearing impairment. There seemed to be no adequate correlation between the appearance of the drum membrane and the anticipated duration of recovery.

Representative audiograms obtained from this group illustrate the marked variations in hearing loss which may result from inadequate ventilation of the tympanic cavity during descent from high altitudes. Chart 1 *A* and *B* demonstrates the type of hearing loss usually considered typical of aviation pressure deafness, i. e., depression of hearing for low tones and little if any diminution of hearing for high tones. Other observers [4] have reported that the losses resulting from changes in barometric pressure were in the hearing for low frequencies. The following evidence shows that this is not entirely true: Chart 2 *A* and *B* exhibits an unusual but occasional hearing loss confined to the frequencies con-

4. (*a*) Campbell, P. A., and Hargreaves, J.: Aviation Deafness—Acute and Chronic, Arch. Otolaryng. **32**:417 (Sept.) 1940. (*b*) Shilling, C. W., and Everley, I. A.: Auditory Acuity in Submarine Personnel, U. S. Nav. M. Bull. **40**:664 (July) 1942. (*c*) Campbell, P. A.: The Effect of Flight upon Hearing, J. Aviation Med. **13**:56 (March) 1942.

sidered essential for intelligibility of speech. It is remarkable that the hearing for the frequencies 128, 256 and 512 was unaffected, while the thresholds for all the tones above 512 cycles per second were elevated. Chart 3 *A* and *B* repre-

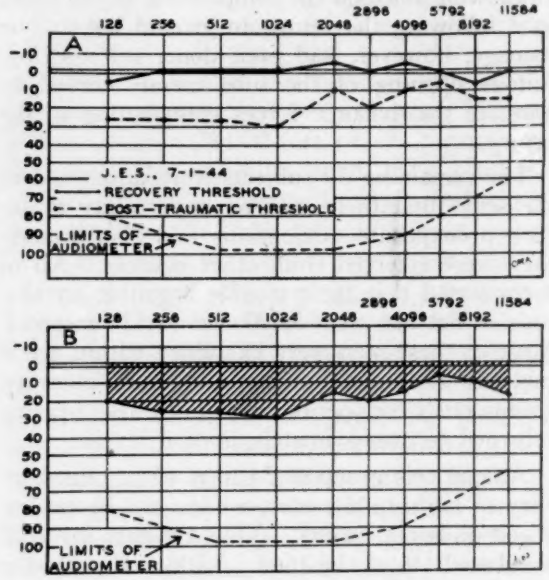


Chart 1.—*A*, audiogram showing preponderant losses in hearing for low tones. *B*, recovery in decibels.

sents progressively greater loss of hearing, ranging from low to high tones. In this case marked losses for the frequencies above 1,024 cycles per

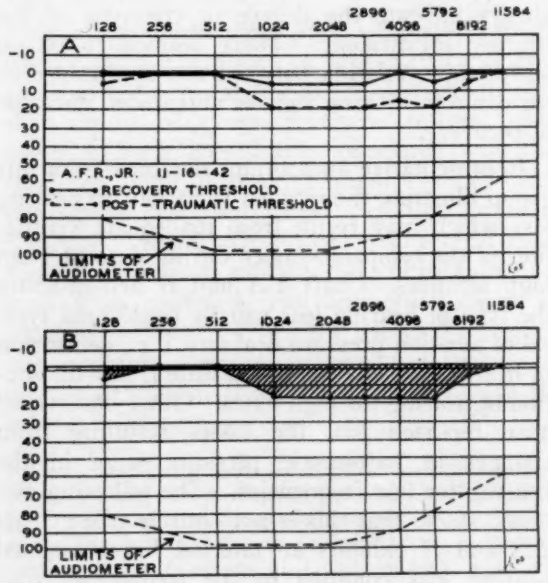


Chart 2.—*A*, audiogram showing losses in the speech range. *B*, recovery in decibels.

second were incurred. Since the intensity delivered by the audiometer is limited to about 60 decibels at 11,584, the full extent of the loss for this frequency could not be determined. Chart 4 *A* and *B* reveals that tonal dips may occur in the higher frequencies. Such dips are not infrequent, though they are not consistently observed at any one particular portion of the audiogram.

These samples show that not only a loss of high tones but a greater loss of high tones above 1,0 may occur. It is believed that this has not been sufficiently emphasized by previous writers, although Teed,[5] Simpson [6] and others have reported its occurrence.

Chart 5 shows those frequencies at which temporary maximum losses of 10 decibels or more occurred among the 94 ears. It is evident that the ears showing preponderant losses for the higher tones outnumber those showing preponderant losses for the lower tones. The frequencies at which the dips most often appeared were 1,024, 5,792 and 11,584. The lowest in-

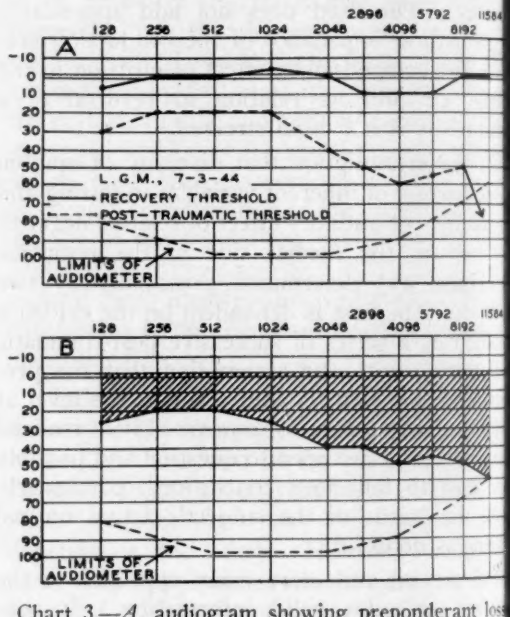


Chart 3.—*A*, audiogram showing preponderant loss for high tones. *B*, recovery in decibels.

dence of maximum losses occurred at 256 and 2,048 cycles per second.

The position of maximum losses in the audible frequency range having been determined, the question concerning the severity of the losses at these frequencies arises. Chart 6 shows the amount of the maximum losses occurring at each of the frequencies tested. This graph supports the contention that the greatest number of ears incurred losses involving the higher frequency range and

5. Teed, W. R.: Factors Producing Obstruction in the Auditory Tube in Submarine Personnel, U. S. Nav. M. Bull. **42**:294 (Feb.) 1944.

6. Simpson, J. F.: General Survey of Otorhinological Considerations in Service Aviation, J. Laryng. & Otol. **57**:1 (Jan.) 1942.

ws in addition that the most severe losses are ong the higher frequencies. Again it may noted that frequencies 256 and 2,048 are ected least in point of incidence and severity earing loss, while 1,024 and frequencies above 48, particularly 11,584, show the greatest

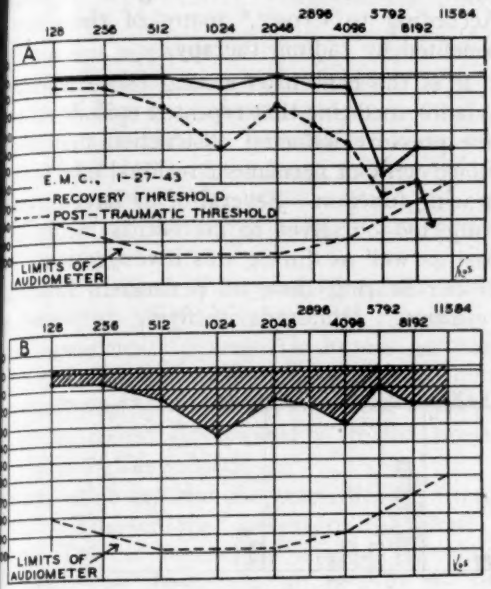


Chart 4.—*A*, audiogram showing tonal dip at frequency 1024. *B*, recovery in decibels.

ses in decibels. In general these results agree th those noted experimentally by Loch.[3b]

Campbell and Hargreaves[4a] expressed the inion that the losses for high tones are due to perimposed auditory fatigue from exposure to ise. This is no doubt true in certain instances, t when the threshold of hearing improves rkedly following inflation of the eustachian be, the influence of noise may well be discounted. So little is known about the duration recovery from auditory fatigue that it would presumptuous to deny that in some of these ses the hearing mechanism was also affected aircraft noise. In others the hearing losses re quite definitely proved to be due entirely obstruction of the eustachian tubes.

Hearing losses regarded as aviation pressure afness exhibit certain characteristics which d themselves to a general classification. This ssification is largely dependent on the frequency and the duration of the aerotympanoal obstruction. There are but two types: mporary and persistent.

Temporary deafness may exhibit a variable gree of severity and involve a wide range of dible frequencies. In some instances the imirment of hearing is negligible. Frequently d despite obvious trauma of the middle ear diograms taken a few minutes after descent show no significant differences when compared with audiograms taken prior to ascent. Occasionally the mechanism of this apparent paradox may be otoscopically observed in development while the compensatory effusion is accumulating within the middle ear.

The prospective course of temporary deafness is conditioned by the contributing causes, which are considered to be: (1) failure of ventilation because of preoccupation, lack of time or opportunity, sleep and unconsciousness; (2) current functional inadequacy of tubal ventilation because of an infection of the upper respiratory tract or congestion resulting from vasomotor alterations; (3) repeated attempts to fly despite unresolved aero-otitis media and nasopharyngitis; (4) anatomic inability of the tubal lumen to provide ventilation during rapid atmospheric changes, though functionally effective while on the ground.

The importance of good management in the prevention of recurrences cannot be overemphasized. Casual treatment of a primary occurrence may permit the tissue changes to progress to irreparable damage of the conduction system of the middle ear. Depending on the magnitude of the initial force and the extent of the secondary injury of tissue, temporary deafness usually resolves within a period ranging from minutes to several hours. Even then incipient causes may remain to interrupt the process of resolution if an attempt is made to fly too soon.

Primary treatment should consist of (1) instillation of a nasal astringent, (2) aspiration of excess secretions and (3) frequent tubal inflation during the first few hours.[7] This procedure has met with criticism on the basis of the complications that may be introduced. On the contrary,

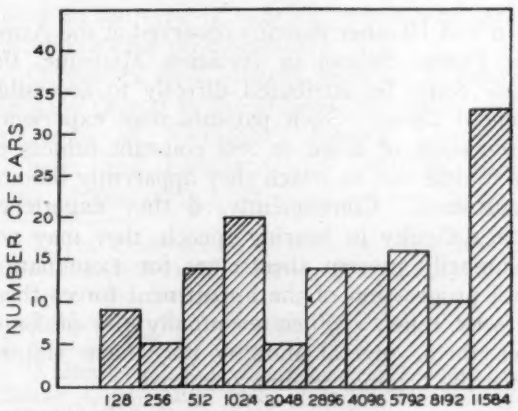


Chart 5.—Distribution of the temporary maximum losses observed at various frequencies among 94 ears.

7. Ogden, F. W.: Modified Politzerization in Treatment of Aero-Otitis Media, unpublished data.

thousands of patients have been treated in this manner without incidence of secondary disease or aggravation of the hearing loss. A thorough search should always be made for predisposing factors, and these should be eliminated as soon as possible. Many of those with temporary deafness from barotrauma require only to refrain from flying until complete resolution of the infection of the upper respiratory tract occurs.

Persistent aviation pressure deafness [8] defines in but few instances deafness associated with tubal obstruction. In the present series only 2 men were considered to have this type of complication. Tubal inflations brought their hearing up to within serviceable levels for only a few hours; then depression followed. Hearing was depressed more for high tones than for low tones.

ease may be reversible if treatment is energ or may become permanent if treatment is n lected or is unsuccessful. Experience teac that most of the men with the persistent type impairment may be restored to full flying d only after a long period of recovery. Some them require corrective surgical procedu According to Crowe,[9] many of them may benefited by radium therapy.

It is the consensus among those working aviation medicine that repeated episodes of ne tive pressure inducing obstruction may be s tained without permanent residual effects on hearing function. Several of us have repeate subjected ourselves to aero-otitis media in past as well as during this investigation. Te of our hearing show no permanent impairm resulting. Hundreds of flying personnel w

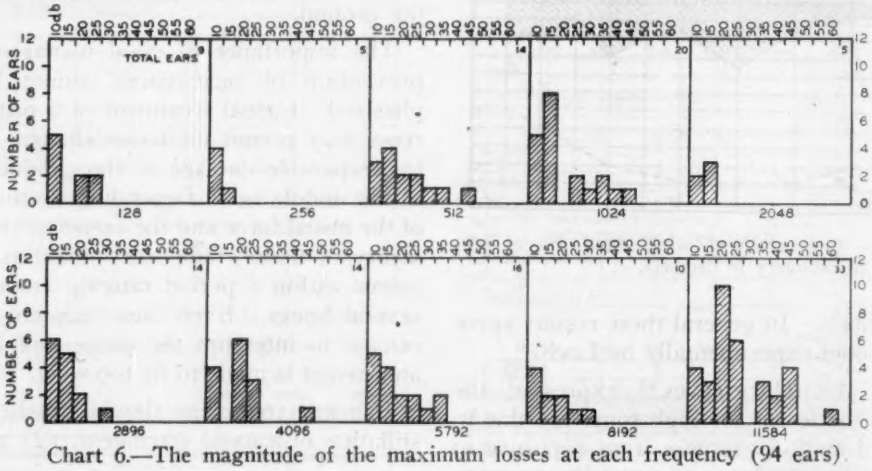


Chart 6.—The magnitude of the maximum losses at each frequency (94 ears)

In 9 of 10 other patients observed at the Army Air Forces School of Aviation Medicine, the cause could be attributed directly to accessible adenoid tissue. Such patients may experience a sensation of more or less constant fulness of the middle ear, to which they apparently become accustomed. Consequently, if they experience little difficulty in hearing speech, they may not voluntarily present themselves for examination until progression of the impairment forces them to seek relief. When eventually the otologist sees them, several months may have elapsed since the original trauma occurred.

Factors contributing to persistent deafness are believed to be (1) pathologic processes prolonged after the precipitating factor and initiating causes have ceased to exist and (2) vital changes in the mucosa of the middle ear and eustachian tube.

Persistent impairment of hearing concurrent with tubal obstruction and nasopharyngeal dis-

have experienced aero-otitis media once or s eral times reveal no permanent impairment hearing in the speech range.

Data obtained from several other sources s gest the conclusion that only an exceptional f of all Air Forces combat personnel will sust aural disabilities resulting solely from alterati in atmospheric pressure coincident with flying However, the incidence of aero-otitis media t may contribute significantly to noneffectiven of flying personnel is still a problem with wh to contend.[11]

Major Hubert B. Peugnet, Medical Corps, Army the United States, and Mrs. Lynn Anderson, laborat aide, Army Air Forces School of Aviation Medic Randolph Field, Texas, gave assistance and advice.

8. Campbell and Hargreaves [4a] described this type as chronic conduction deafness.

9. Crowe, S. J., and Baylor, J. W.: The Prev tion of Deafness, J. A. M. A. **112**:585 (Feb. 18) 1 Crowe, S. J.: Personal communication to the auth

10. Wright, R. W.: Aero-Otitis, unpublished d

11. Captain F. W. Ogden, Medical Corps, Army the United States, assisted in the observations evaluations of this study.

EFFECT OF AIRCRAFT NOISE ON HEARING

CAPTAIN BEN H. SENTURIA
MEDICAL CORPS, ARMY OF THE UNITED STATES

There has appeared recently a series of reports emphasizing the high incidence and the severity of hearing defects among personnel returning from combat. In addition, there have been statements as to the large numbers of Air Forces personnel who would return as "ear cripples" after the termination of the present conflict.

Because marked divergence of opinion exists concerning the incidence and the character of these impairments among Air Forces personnel and the extent to which they may be attributed to aircraft noise, I should like to discuss some of the more recent developments in the present knowledge of this subject.

First, what are the characteristics of aircraft noise? Consider the cockpit of the plane in flight. This is essentially a closed chamber, separated from the outside air by only the thin wall of the fuselage, within which are seated one or more persons. Since the principal sources of noise (the motor, the propeller and the slipstream) are outside this chamber, it is evident that in order to affect the occupants the outside noise must penetrate the chamber walls. Once the sound has gained access to the interior it bounces back and forth by reflections until its energy is dissipated by encountering sound-absorbing material. In any airplane, if little sound energy comes through the walls, little sound-proofing is required and, conversely, if the plane windows are wide open, all the sound-proofing possible will not prevent the noise from being about the same inside as outside.

In general, the low tones of aircraft noise, having great sound energy, will easily set the thin walls of the fuselage into vibration, and they in turn act like the diaphragm of a loudspeaker, generating the sound into the interior of the cabin. The higher frequencies, having less energy and being less easily transmitted, will penetrate a smaller volume. If windows and ventilators are kept opened, more of the high frequencies will enter (which will change the contour of the noise spectrum but will not greatly increase the over-all intensity of the noise). In general, then, most combat aircraft will show a typical noise spectrum with the most intense noise in the low frequencies.

Because of military necessity, at least for the present, noise levels in most combat aircraft must remain alarmingly high. In a B-25 noise levels of 120 to 125 decibels have been measured, and in an advanced trainer with open canopy a level of 128 decibels has been observed. A noise level of this magnitude not only causes auditory fatigue but approaches the level of actual pain.

On the other hand, the larger bombers can afford the luxury of sound treatment, and consequently the noise levels in the B-17 and the B-24 are of only moderate intensity (average, 110 decibels) and those in the B-29 are reasonably low (average, 95 decibels).[1] Most members of an aircrew are required by their duties to wear head phones, which attenuate noise by 15 to 30 decibels, and, in addition, are advised to use cotton ear plugs or ear protectors, which further attenuate the volume of noise (especially the high frequencies) reaching the ear.

Now that the nature of the fatiguing noise has been briefly discussed, I shall direct attention next to the type of hearing encountered among candidates for pilot training.

Otologists have already been made aware of hearing defects in the general population by such pioneers as Newhart,[2] Shurly,[3] Coats[4] and Fowler and Fletcher.[5] In addition, Bunch,[6] and Montgomery[7] classified patients according

This article and the two articles by Colonel Campbell and Lieutenant Colonel Kos were presented as a Symposium on the Present Status of the Problem of Aviation Deafness at the meeting of the American Academy of Ophthalmology and Otolaryngology in Chicago, Oct. 3, 1944.

1. The measurements of the noise levels were made by Major Hubert B. Peugnet, Medical Corps, Army of the United States.

2. Newhart, H.: Hearing Problems in Education, J. A. M. A. **109**:839 (Sept. 11) 1937.

3. Shurly, B. R.: Prevention of Deafness in the School Child, Ann. Otol., Rhin. & Laryng. **46**:223 (March) 1937.

4. Coates, G. M.: Prevention of Deafness, Am. Otol., Rhin. & Laryng. **40**:651 (Sept.) 1931.

5. Fowler, E. P., and Fletcher, H.: Three Million Deafened School Children, J. A. M. A. **91**:1181 (Oct. 20) 1928.

6. Bunch, C. C.: Age Variations in Auditory Acuity, Arch. Otolaryng. **9**:625 (June) 1929.

7. Montgomery, H. C.: Do Our Ears Grow Old? Bell Lab. Rec. **10**:311, 1932.

to ages and demonstrated the high tone variations with age. Rodin [8] studied 36,191 school children (9 to 16 years of age) and found that 9.5 per cent had losses of 9 or more sensation units in one or both ears. Beasley and his associates [9] examined 4,364 persons (8 to 76 years old) and observed that only 38 per cent had "normal" hearing. Crowe and co-workers [10] in a study of 672 boys (8 to 14 years of age) found that less than 47.3 per cent had "normal" hearing.

From this brief survey of the literature one is made aware of the fact that one must not expect so-called "normal" hearing even among the young men who are so carefully chosen to become members of aircrews. Staff members tested 500 sound-isolated rooms in which there was decibels or less of ambient noise. All audiome and sound-measuring equipment were calibra with the assistance of Major Hubert B. Peug

The audiograms were typed and graded cording to the following system, which is so what similar to those described previously Guild,[12] Fowler [13] and Beasley.[9] On the b of the configuration of the threshold curves, t were classified into four types, viz.: A, V, W T, and were graded 0 to 4 according to the se ity of the loss at any one or more frequenc These designations were selected to facili treatment and the analysis of large groups audiograms in our statistical studies and have

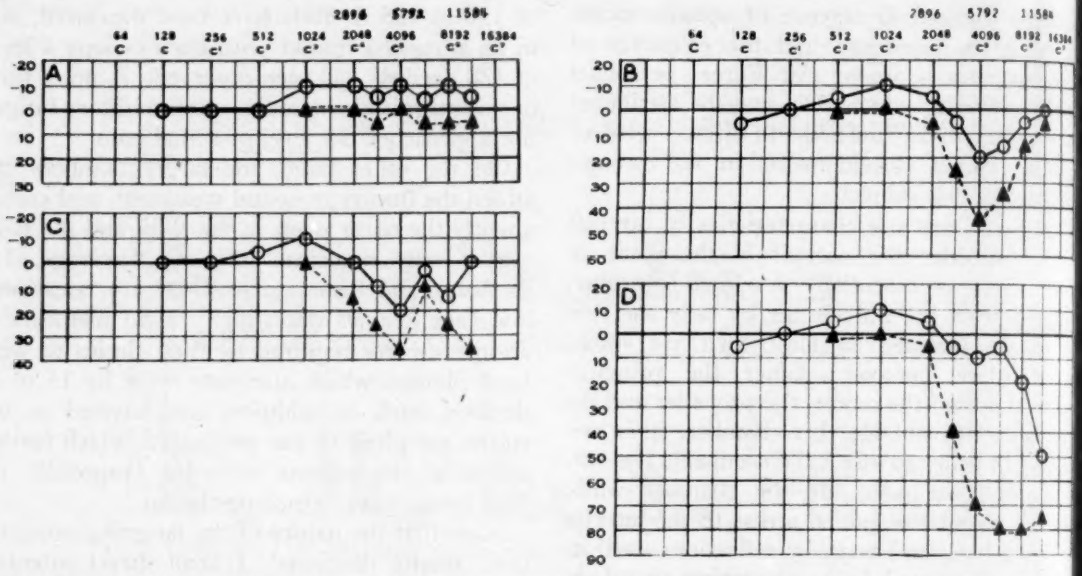


Chart 1.—Sample threshold curves showing types and grades of audiograms. *A*, type A; *B*, type V; type W; *D*, type T. Circles represent one grade and triangles another grade, as explained in the text on page. Frequency and pitch (C, c, c^1 to c^7) are shown on the abscissas; loss in decibels on the ordinates.

of these healthy men between the ages of 18 and 27.[11] All had passed the physical requirements for pilot training, had little or no flying experience and had not been exposed to any aircraft noise for approximately thirty days.

Tests for auditory thresholds were performed by five examiners of the permanent staff in

organic or pathologic basis. In chart 1 are sa ples of the various types and grades of aud grams. Two grades of curves are presented each type, one designated by circles and the oth by black triangles. The types mentioned cover the following cases:

Type A—all cases showing no more than a 10 dec variation from the accepted zero (normal) line.

Type V—those cases showing typical and clearcut notching or a tonal dip of more than 10 decibels.

Type W—those showing the V notch but having additional loss of more than 10 decibels in the hig or the lower frequencies.

Type T—those characterized by a progressive or va able high tone loss greater than 10 decibels.

In order to record the severity of the heari loss (chart 2), threshold curves were grad numerically:

Grade O—plus or minus 10 decibels with refere to the zero line.

Grade 1—losses of 15 to 20 decibels.

8. Rodin, F. H.: Survey of the Hearing of the School Children of San Francisco, Arch. Otolaryng. **11**:463 (April) 1930.

9. Beasley, W. C.: The General Problem of Deafness in the Population, Laryngoscope **50**:856 (Sept.) 1940.

10. Crowe, S. J., and others: Impaired Hearing in School Children, Laryngoscope **52**:790 (Oct.) 1942.

11. Senturia, B. H.: Auditory Acuity of Aviation Cadets, Ann. Otol., Rhin. & Laryng. **53**:705 (Dec.) 1944.

12. Guild, S. R.: A Method of Classifying Audiograms, Laryngoscope **42**:821 (Nov.) 1932.

13. Fowler, E. P.: Deafness in School Children, Arch. Otolaryng. **6**:43 (July) 1927.

Grade 2—losses of 25 to 40 decibels.
Grade 3—losses of 45 to 60 decibels.
Grade 4—losses greater than 60 decibels.

must be noted that this grading system takes o consideration losses at any one or more of en discrete frequencies (1,024 to 11,584 cy- s per second) and is not to be confused with method of averaging losses for three or four ected frequencies.

Chart 3 shows the distribution of the various es of audiograms among the 500 subjects

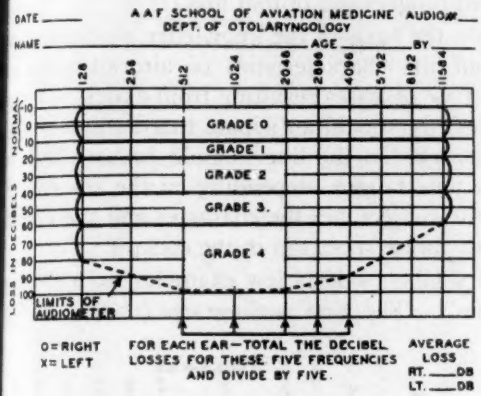


Chart 2.—System used in grading audiograms.

,000 ears) tested. It is seen that only 33 per nt of the ears showed threshold curves which not deviate more than 10 decibels below the cepted zero line at any frequency from 1,024 11,584 (type A). This is in essential agree- nt with Crowe and co-workers,[10] especially

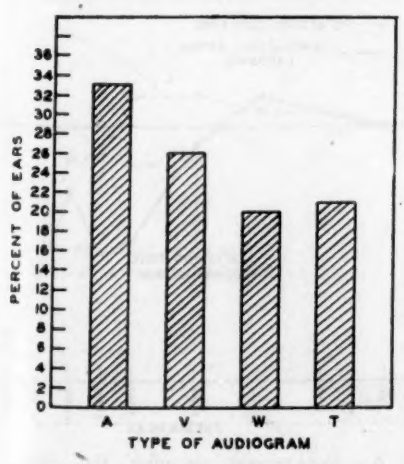


Chart 3.—Distribution of types of audiograms among 00 ears.

hen it is recalled that their subjects are in a ounger age bracket.

Tonal dips of 15 decibels or more (type V) curred in 26 per cent of the ears. This is a eater percentage than occurred in a series of children reported by Loch[14] and confirms the impression that V notches occur in children and that up to a certain undetermined age there is an increase in the incidence of these tonal dips. It is to be emphasized here that these dips are above the speech range and are therefore undiscovered except on routine audiograms, since they do not interfere with the hearing of ordinary speech.

Type W losses occurred in 20 per cent of the ears and are considered the product of the superimposition of additional losses on the simple V notch. Four of 5 of the audiograms designated as type W showed typical tonal dips of 15 decibels or more.

The finding of type T losses in so large a percentage of these ears (21 per cent) is consistent with observations made by Crowe and co-workers[10] and by Goldstein and myself[15] among "normal" school children. It is conceivable that type V losses under the influence of age and

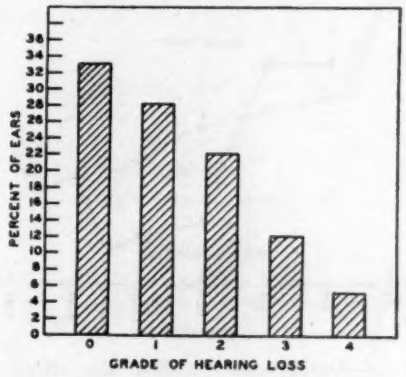


Chart 4.—Distribution of grades of losses among 1,000 ears.

prolonged acoustic trauma may be converted to type W and, with continued abuse, into type T deafness.

Chart 4 shows the distribution of grades of losses among these 1,000 ears. As one would anticipate, there is a small percentage with severe hearing losses (grade 4), while a preponderance of the ears show normal hearing (grade O) and minor deficiencies (grades 1 and 2).

Now I shall turn to a consideration of the effect of pure tones and aircraft noise on these auditory thresholds. At the Army Air Forces School of Aviation Medicine we have had the opportunity of studying these effects both in the laboratory and "on the line." Our experiences have been in general agreement with those reported by Camp-

14. Loch, W. E.: Incidence and Permanency of Tonal Dips in Children, Laryngoscope **53**:347 (May) 1943.

15. Senturia, B. H., and Goldstein, M.: Unpublished data.

bell and Hargreaves,[16] Stevens and Davis,[17] Perlman,[18] Kemp [19] and others.

In the laboratory we have been able to confirm the fact that auditory fatigue can be regularly produced with pure tones in all persons. To be sure, susceptibility varies, so that this temporary loss occurs more readily in some persons

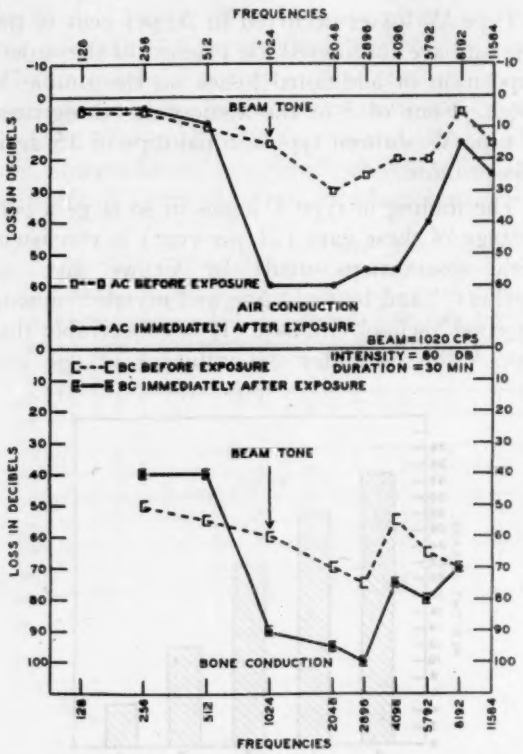


Chart 5.—Audiograms showing the effect of exposure to the radio beam. *AC,* air conduction; *BC,* bone conduction; *CPS,* cycles per second.

than in others, and susceptibility also seems to vary in the same person from time to time without adequate explanation. The temporary loss produced by prolonged stimulation is not limited to the immediate region of the fatiguing tone but is widespread at and above that tone (chart 5). When dealing with fatiguing periods up to one hour and with intensities up to 90 decibels we found no losses below the fatiguing tone.

Recovery from the fatiguing tone was highly variable. Some subjects recovered in a period of minutes. A few susceptible subjects requir weeks for complete recovery. There has been consistency about rates of recovery, but a go rule of thumb suggested by Campbell and Ha greaves [16] is that the recovery time approach the square of the exposure time.

Contrary to a popular belief, we have seen tendency for those who have perceptive heari losses (type T) to show an unusual sensitivi or susceptibility to auditory fatigue (chart Thus, if one has a high tone loss, it is not nec sarily true that exposure to noise will result in rapid progression of that loss.

On the basis of the knowledge we have gain about the characteristics of aircraft noise a the type of losses resulting from exposure to pu tones, we should anticipate that auditory fatig observed "on the line" should be both high a low tone fatigue, depending on the susceptibili of the subject and the character and the intensi of the noise spectrum in the cockpit.

I shall consider a few examples from the flyi "line." The first audiogram (chart 7) sho

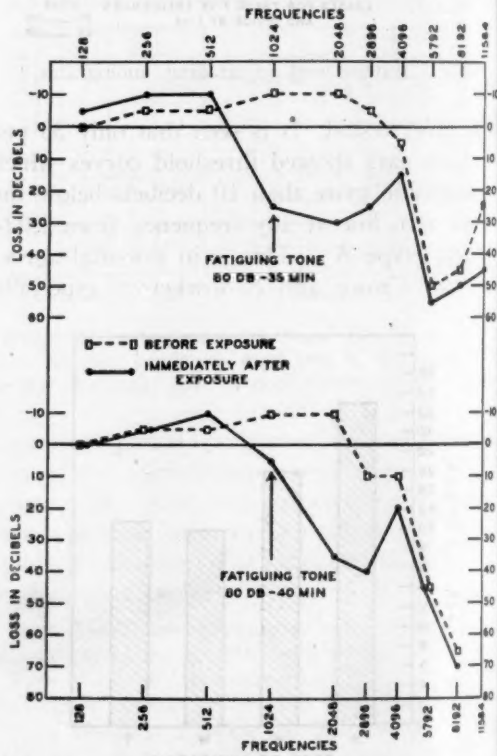


Chart 6.—Audiograms showing the effect of e posure to pure tone on type T (perceptive) heari curves.

the hearing loss following a 9 hour flight in single engine basic training aircraft. It is ev dent that the loss is spread over the auditor spectrum from 128 to 8,192 cycles per secon but seems to peak in the region of 2,048.

16. Campbell, P. A., and Hargreaves, J.: Aviation Deafness—Acute and Chronic, Arch. Otolaryng. **32**:417 (Sept.) 1940.

17. Stevens, S. S., and Davis, H.: Hearing: Its Psychology and Physiology, New York, John Wiley & Sons, Inc., 1938.

18. Perlman, H. B.: Acoustic Trauma in Man, Arch. Otolaryng. **34**:429 (Sept.) 1941.

19. Kemp, E. H.: A Critical Review of Experiments on the Problem of Stimulation Deafness, Psychol. Bull. **32**:325 (May) 1935.

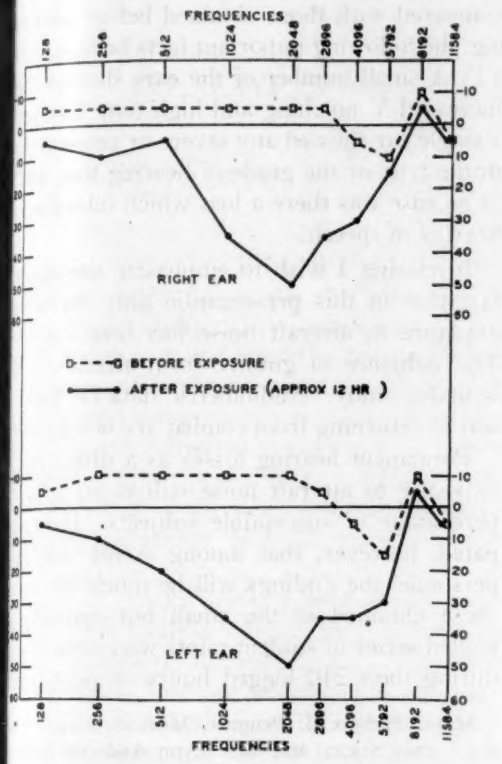


Chart 7.—Audiograms showing hearing losses following a 9 hour flight in a single engine basic training craft.

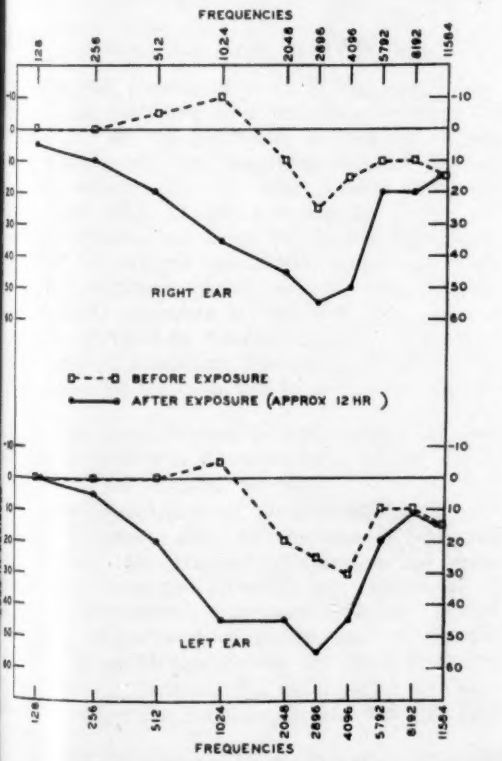


Chart 8.—Audiograms showing high and low frequency hearing losses following a 6 hour flight in an advanced single engine training aircraft.

The next audiogram (chart 8) shows hearing losses after a 6 hour flight in a more powerful single engine advanced trainer. The losses involve both low and high tones.

Chart 9 represents auditory fatigue in a patient who had a severe V notch previous to flight. He then flew for 10 hours in a single engine advanced training plane. Here, just as in the laboratory, the additional loss is not in the region of the original defect but is distributed throughout the low and middle frequencies.

From the foregoing consideration it is clear that hearing losses can occur as a result of exposure to aircraft noises, but this does not answer the important question as to whether these losses

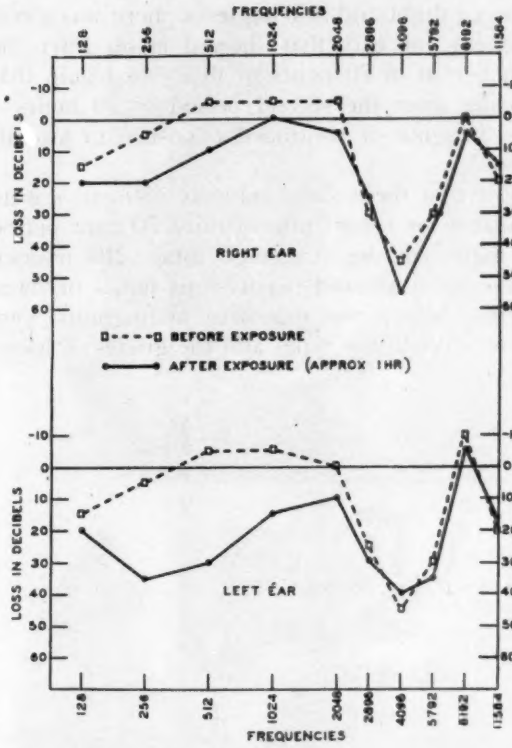


Chart 9.—Audiograms showing the effect of a 10 hour flight in an advanced single engine training aircraft on the type V hearing curve.

are permanent. To answer this question, 100 aviation cadets who had passed their rigid physical examination and had records of 20/20 hearing for whispered voice were selected for study. These men had no more than 10 hours of flying experience, and at the time of examination had not been exposed to airplane noise for thirty days. During the period of observation, which extended over 210 hours of logged flying time, audiograms were made by the same examiner before and after each of three periods of pilot training.

After the first period, 74 of the original 100 men were available for retests. Because the train-

ing schedule could not be interrupted, these tests were made a few hours after the completion of the daily flight exercise. At this time 19 per cent of the ears tested showed a hearing loss of 15 decibels or more at one or more frequencies (1,024 to 11,584 cycles per second), while only 11 per cent showed gains. There was a real tendency for these losses to be associated with the sound frequencies 2,896, 4,096 and 5,792.

Sixty-four of the original 100 subjects were retested after an additional 70 hours of flight in a more powerful single engine aircraft (average total, 140 hours). Because of training schedules, audiograms were obtained two to eight hours after the completion of the daily period of instruction. Despite the very short interval of rest between flight and hearing tests, there was a real tendency for ears that showed losses after the first period of 70 hours of flying to regain that hearing after the second period of 70 hours—this, in spite of continued exposure to aircraft noise.

Forty of these same subjects (80 ears) were available for retests after a third 70 hour period of flight training (average total, 210 hours). These were allowed twenty-four hours or more of rest before the repetitive audiograms were made. When the types and the grades of losses found after this 210 hours of logged flying w compared with those obtained before pilot tr ing, the following important facts became evid (1) A small number of the ears showed slig increased V notching and high tone loss, but a single ear showed any severe or unusual cha in the type or the grade of hearing loss, and in no case was there a loss which interfered hearing of speech.

In closing I wish to emphasize the impor fact that in this presentation only the effec exposure to aircraft noise has been conside The influence of gunfire from aircraft in fl is under study. Audiometric data on flight sonnel returning from combat are being collec

Permanent hearing losses as a direct resul exposure to aircraft noise will occur in a s percentage of susceptible subjects. It is an pated, however, that among Army Air Fo personnel the findings will be much the sam those obtained in the small but carefully c trolled series of student pilots who were obser during their 210 logged hours of pilot train

Major Hubert B. Peugnet, Medical Corps, Arm the United States, and Mrs. Lynn Anderson, labora aide, Army Air Forces School of Aviation Medi Randolph Field, Texas, gave assistance and advi

INHALATION METHOD FOR PENICILLIN THERAPY

PRELIMINARY REPORT

E. W. HAGENS, M.D.; MARY KARP, M.D., AND C. J. FARMER, M.A.

CHICAGO

In *Science*, July 14, 1944, Bryson, Sansome and Laskin [1] reported on the aerosolization of solutions of penicillin. They stated that experiments by themselves and others had demonstrated that solutions of penicillin could be successfully aerosolized and the penicillin recovered from the lungs of animals subjected to the vapor. Human subjects were given penicillin by inhalation, and up to 60 per cent of the penicillin, depending on the technic, was recovered in the urine in twelve hours.

In view of this favorable report and the possibilities of the method we decided to use inhalations of penicillin therapeutically. The first objective was to find out whether penicillin was sufficiently well absorbed by this method to be of practical value; the second objective was to investigate the results of the inhalation of penicillin in several types of patients, principally those with pulmonary conditions, for in such patients the additional value of local therapy is manifest.

APPARATUS AND METHOD

Our equipment consists of an O. E. M. mask [2] (oronasal) without the valve (this permits rebreathing), a DeVilbiss no. 40 nebulizer and a tank of oxygen equipped with a regulator supplying about 7 liters of oxygen per minute (fig. 1). The patient inhales the penicillin mist (fig. 2) for five minutes hourly for fourteen treatments, and twice during the night, making a total of sixteen treatments each twenty-four hours. The treatment period, normally five minutes, may be varied somewhat by selection of a rate of oxygen flow sufficient to nebulize 1.5 cc. (12,000 units) of the solution of penicillin. The course of daily treatments is continued for from two to seven days, depending on the condition of the patient, and if the lungs are diseased, depending on the bacteriology of the sputum. The sputum of the patient is cultured daily. The blood levels (Flemming's [3] adaptation of the Wright slide cell technic) and the urine level (Oxford cup

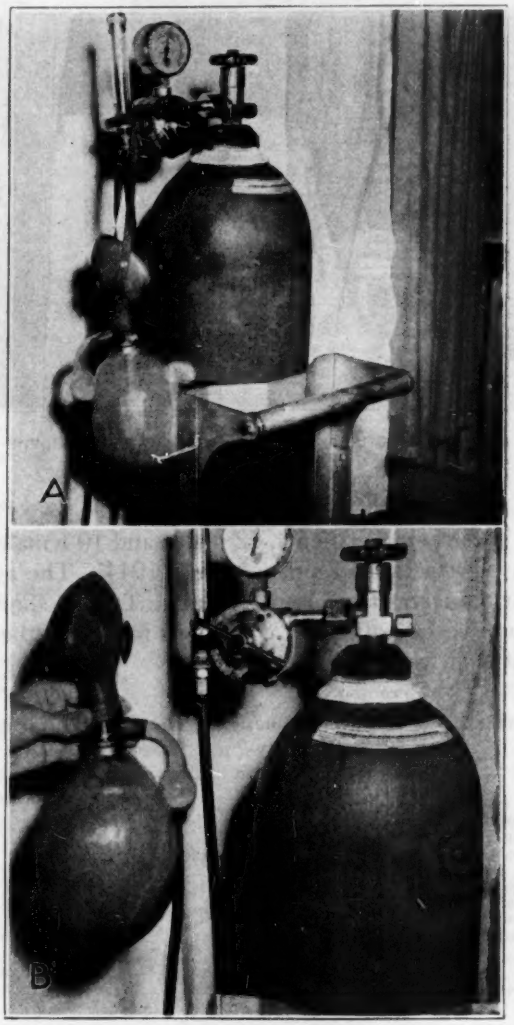


Fig. 1.—*A*, oxygen tank, O. E. M. mask and nebulizer. *B*, close-up view of the oxygen tank, the O. E. M. mask with the bag used for partial rebreathing, and the DeVilbiss nebulizer no. 40 containing the solution of penicillin.

Part of the penicillin used in these studies was furnished by the Penicillin Research Fund of the Northwestern University Medical School.

From the Department of Otolaryngology, Wesley Memorial Hospital, and Northwestern University Medical School (Dr. Hagens); Department of Anesthesia, Wesley Memorial Hospital, and Department of Surgery, Northwestern University Medical School (Dr. Karp); Department of Biochemistry of Northwestern University Medical School (Professor Farmer).

1. Bryson, V.; Sansome, E., and Laskin, S.: Aerosolization of Penicillin Solutions, Science **100**:33 (July 14) 1944.

2. The mask is marketed by the Oxygen Equipment Manufacturing Company.

3. Heilman, S. H., and Herrell, W. E.: The Use of Flemming's Modification of the Wright Slide Cell Technic for Determining Penicillin in Body Fluids, Am. J. Clin. Path. **15**:7 (Jan.) 1945.

method [4]) are also determined every twenty-four hours, and the blood count, the sedimentation rate, other laboratory data and roentgenograms are obtained as indicated.

The solution of penicillin contains 8,000 units per cubic centimeter dissolved in equal parts of distilled water and peppermint water U. S. P.; the peppermint water is added to mask the musty odor of the mold. A total of 192,000 units of penicillin is used each twenty-four hours in the sixteen treatments. The amount of penicillin used each day was arbitrarily chosen, as there was no previous standard to follow. The length of a course of treatment was set at about seven days, although some patients were treated ten to twenty days. One patient (bronchiectasis) has returned for monthly courses of treatment of two days each. One patient with pneumonia was treated for only two days (patient 22).

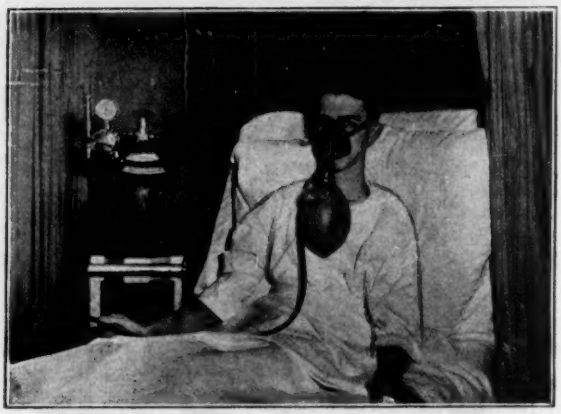


Fig. 2—A patient taking the inhalation treatment.

REPORT OF RESULTS

Twenty-two patients, 12 males and 10 females, have been treated since August 1944. The age variation was from 5 to 70 years. Table 1 shows the types of pathologic conditions for which these patients were treated.

TABLE 1.—*Pathologic Conditions Diagnosed Clinically in the Twenty-Two Patients*

	Patients
Bronchiectasis	6
Chronic bronchitis (bronchiectasis)	2
Bronchiectasis and other conditions (allergy, cardiac disease, tuberculosis)	2
Allergy (asthma) predominating	4
Pneumonia	5
Abscess of lung	1
Pharyngitis—sinusitis	2
Total	22

Table 2 shows the number of initial specimens of sputum in which the various bacteria occurred, as demonstrated on culture.

Table 3 reveals the bacteria found on culture in specimens of sputum taken one to three days after treatment commenced.

4. Foster, J. W., and Woodruff, H. B.: Microbiological Aspects of Penicillin: VI. Procedures for the Cup Assay of Penicillin, J. Bact. **47**:43 (Jan.) 1944.

It can be seen from tables 1, 2 and 3 inhalations of penicillin quickly cause the appearance of the gram-positive bacteria that the gram-negative bacteria persist and so times even appear although absent in the orig cultures. Penicillinase has not been added to specimens of sputum, but this phase is to investigated, as such an addition may cha the bacteriologic results. In 1 case of bronch tasis a second antibiotic substance was inhaled, and while both drugs were being adm istered no bacteria were found on culture. soon as the use of the second antibiotic s stance was stopped Proteus vulgaris reappea

Assays of urine are difficult to evaluate bec of such factors as the possible presence of c form bacteria and the improper handling of twenty-four hour specimens. However, in s cases up to 20 per cent of the penicillin nebul was recovered. It is believed that in the fut

TABLE 2.—*Bacteriologic Findings in Initial Speci of Sputum Before Treatment*

Streptococcus nonhaemolyticus
Streptococcus haemolyticus
Streptococcus viridans
Diplococcus pneumoniae
Staphylococcus albus
Staphylococcus aureus
Neisseria catarrhalis
Proteus vulgaris
Micrococcus tetragenus

TABLE 3.—*Bacteriologic Findings in Specimens Sputum Taken One to Three Days After Treatment Commenced*

Proteus vulgaris (only)
Proteus vulgaris and N. catarrhalis and others
Escherichia coli
E. coli and Escherichia pyogenes
Aerobacter aerogenes
Str. nonhaemolyticus, N. catarrhalis, Staph. aureus
No growth

with our improved technic, much higher le will be obtained. There have been unexpla variations in the blood serum level, and obse tions are being continued. Most tests have i cated levels below 0.03 unit of penicillin cubic centimeter of blood serum.

Reactions, probably due to penicillin, occu in 4 patients. One patient showed a tempo dermatitis, while 3 patients had transient fe The therapy was discontinued in the first pati In the last 3 patients it was carried on wi solution containing one half the number of u of penicillin previously used and then, a twelve hours, resumed with the solution at strength. One of these patients (6, table has had fever and dyspnea following his re two day courses of treatment, although his course of seven days produced no evidence reaction.

TABLE 4.—*Patients Treated with Penicillin*

Patient	Age, Yr.	Clinical Diagnosis	Cultures: Before Treatment	Cultures: After Treatment	Length of Treatment	Result
Ted	22	Bronchiectasis	Str. nonhaemolyticus, Staph. albus, N. catarrhalis	Proteus vulgaris	10 days	Less secretion; general condition improved; less odor on bronchoscopy. Later, following respiratory infection, as before treatment
Louis	34	Bronchiectasis	Str. nonhaemolyticus, Staph. albus, D. pneumoniae	Proteus vulgaris	7 days	Less secretion; general condition improved. Later, following respiratory infection, as before treatment
Mrs. F.	23	Bronchiectasis, abscess of lung, tuberculosis	Str. viridans, Staph. albus, D. pneumoniae, N. pharyngeus siccus	Proteus vulgaris	9 days	Patient felt better preoperatively, during treatment
Mr. B.	58	Bronchiectasis	Staph. albus, Str. nonhaemolyticus, M. tetragenus, D. pneumoniae, Proteus vulgaris	Proteus vulgaris	7 days	General condition improved; sputum decreased 75 per cent
Mr. E.	61	Asthma	Str. haemolyticus, Staph. albus, Str. nonhaemolyticus, N. catarrhalis	Proteus vulgaris	7 days	General condition improved; sputum considerably decreased
Earl	17	Bronchiectasis	Str. viridans, Staph. albus, N. catarrhalis, D. pneumoniae, Proteus vulgaris	Proteus vulgaris, 2d course, N. catarrhalis, 3d course, Aerobacter aerogenes	7 days; 2d course, 2 days; 3d course, 2 days; 4th, 2 days	General condition improved; less secretion; patient felt better after each short course
Mrs. A.	56	Atypical pneumonia (sulfonamide compound given 4 days)	Pneumococcus type 22, Str. nonhaemolyticus, N. catarrhalis, Staph. albus	Proteus vulgaris, N. catarrhalis, Str. nonhaemolyticus Streptothrix buccalis	10 days	Temperature reduced to normal in 24 hours. On release, roentgenogram still showed pneumonia; slow recovery at home
Travis	11	Bronchiectasis	Str. nonhaemolyticus, Staph. albus, Proteus vulgaris, D. pneumoniae, Str. buccalis	Proteus vulgaris	15 days	Much less cough and sputum
Mr. C.	70	Bronchiectasis ?, cardiac disease ?	Str. viridans, Staph. albus, N. catarrhalis	E. coli, E. pyogenes	7 days	No improvement; some relief with theophylline and ethylenediamine
Mrs. N.	68	Acute bronchitis, bronchial asthma, general arteriosclerosis	Str. viridans, Staph. albus, D. pneumoniae, N. catarrhalis, Streptothrix buccalis	Proteus vulgaris	7 days	Improvement; reaction of mouth and skin; treatment stopped—recovery in several days; patch test negative
Mrs. W.	45	Chronic arthritis, chronic nasopharyngitis	Str. nonhaemolyticus, Str. viridans, Staph. aureus, Staph. albus, N. catarrhalis	Proteus vulgaris	11 days	No improvement except joints less tender
Mrs. G.	50	Bronchiectasis, allergy	Str. viridans, Staph. albus, D. pneumoniae, N. catarrhalis	Proteus vulgaris, N. catarrhalis	7 days	Patient feels slightly better; less sputum; dyspnea still present
Mrs. D.	50	Bronchiectasis ?	Pneumococcus, Str. nonhaemolyticus, Staph. albus, Gm. — diplococci, Gm. — bacilli	Proteus vulgaris	7 days	Less cough and expectoration; patient feels better
Mr. G.	52	Allergy, asthma, cardiac disease ?	Str. viridans, Staph. albus, N. catarrhalis, Proteus vulgaris	Proteus vulgaris	7 days	No improvement
Miss D.	44	Subacute antritis, pharyngitis	Str. haemolyticus, Staph. albus, N. catarrhalis, Str. nonhaemolyticus	N. catarrhalis, Gm. — rods (Proteus vulgaris)	3 days	Patient recovered; chill and fever first day of treatment—patient felt better in 12 hours; treatment resumed; patch test negative
Earl L.	5	Chronic bronchitis, bronchiectasis ? acute catarrhal otitis media	Str. nonhaemolyticus, Staph. albus, N. catarrhalis, Staph. aureus	.....	7 days	General condition improved; less cough
Mrs. S.	50	Abscess of lung following pneumonia	Str. nonhaemolyticus, Staph. albus, M. tetragenus, N. catarrhalis	Gm. — rods (Proteus vulgaris)	20 days	Patient coughs less; temperature normal; roentgenogram shows much improvement
Miss W.	52	Atypical pneumonia	Str. viridans, N. catarrhalis, Staph. albus, Staph. aureus, D. pneumoniae	Proteus vulgaris	6 days	Fever developed several times—treatment stopped 6th day; some improvement
Mr. P.	26	Pneumonia	Str. viridans, Staph. albus, Staph. aureus, N. catarrhalis, D. pneumoniae	Negative	3 days	Temperature to normal in 3 days; general condition much improved
Janet	13	Atypical pneumonia	Str. viridans, Staph. albus, N. catarrhalis, M. tetragenus, Leptothrix buccalis	Negative	11 days	Temperature to normal; cough and expectoration continued for several days; recovery
Mr. K.	27	Bronchiectasis	Str. nonhaemolyticus, Staph. albus, N. catarrhalis	E. coli	9 days	General condition improved; slightly less cough, expectoration and odor
Mr. V.	21	Lobar pneumonia	D. pneumococcus, Staph. aureus, M. tetragenus, Staph. albus, Str. viridans	Staph. aureus, N. catarrhalis, Str. nonhaemolyticus	2 days	Patient recovered rapidly

It is difficult to evaluate therapeutic results in a preliminary report, and especially so when chronic infections are involved. Table 4 gives a brief summary of the effects of treatment. A study of the data on the 6 patients with bronchiectasis reveals less cough and secretion in those patients on dismissal, but a recurrence to the prepenicillin status in 2. In these 2 patients shortly after treatment bronchoscopic examination revealed less odor, less secretion and slightly less congestion. Following a respiratory infection, the bronchoscopic appearance reverted to that noted at the original observation. The 2 patients with questionable bronchiectasis improved. One patient having bronchiectasis and tuberculosis died after pneumonectomy, and 1 having asthma and bronchiectasis showed no lessening of her dyspnea. Of 4 patients with allergy predominating, 2 feel better, while 2 are unimproved. All of the 5 patients with pneumonia were improved, the temperature curve coming down to normal. However, 3 of these patients had an atypical type of the condition, and full recovery was slow. The administration of a sulfonamide compound for several days had previously failed to aid these patients. Of the 2 patients with pharyngitis-sinusitis, 1 recovered, and the 1 patient having abscess of a lung made an uneventful recovery.

SUMMARY AND CONCLUSIONS

Twenty-two patients were treated with pe
cillin by the inhalation method.

Urine and blood levels show that the dr
is absorbed from the lungs to a sufficient deg
to offer another method when penicillin thera
is indicated. Further confirmation is being c
ried out.

The inhalation method probably has an ad
tional advantage over other methods of adm
istering penicillin, due to its local effect. F
this reason the inhalation of penicillin may be t
method of choice in cases of pulmonary diseas

The inhalation of penicillin results in tem
rary improvement in bronchiectasis, but the co
dition frequently lapses back shortly after thera
is discontinued. In most cases gram-negati
bacteria are encountered, so that another an
biotic substance is also necessary, one to wh
these bacteria are sensitive.

Asthmatic patients who have a superimpos
bronchial infection with an organism to wh
they possibly are allergic may be favorab
influenced by treatment.

Acute pulmonary conditions respond to t
inhalation treatment, and the method may
used advantageously in children and in oth
patients when the usual methods of treatme
such as the intravenous or the intramuscul
injection of penicillin, are unsuitable.

USE OF MICROCRYSTALS OF SULFATHIAZOLE IN OTOLARYNGOLOGIC PRACTICE

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PHILADELPHIA

INTRODUCTION

The modern miracle of therapy with sulfonide compounds already is taken for granted. ere are some writers who condemn the indisminate use of the drugs of this group; on the er hand new uses are described frequently. ow necessary and how dangerous are these mpounds? Toxicity and sensitization are not gligible hazards, and prolonged or repeated plication is not required to develop them. rthermore, as Schenck [1] has warned, unless ere is comprehension of the underlying pathoic process, the drug may merely mask symptms while the infection progresses to disaster.

The increasing topical use of sulfonamide comunds is predicated on the advantage of greater ncentration at the site of infection and the ser likelihood of toxic effects. Local applicaon is to be preferred to systemic whenever ually good results may be expected. Osgood [2] pressed the opinion that one should weigh the k of the therapy against the risk of the disease d should know that the organism producing e disease is susceptible to the action of the ug being used. Such a concept would markedly rtail the frequency of use. But Novak [3] conuded that:

1. In sufficiently high concentrations, such as are esent in local treatment, all of the common sulfonide derivatives are bacteriostatic to all species of cteria.

2. Specificity of drug action against a given bacrium is demonstrated only in lower concentrations ch as those obtained in systemic treatment.

3. . . . for local treatment, the accessibility of e wound and the solubility of the drug should receive e most consideration.

4. Specificity of action as demonstrated in the test be cannot be used as the sole criterion for the selecn of a sulfonamide derivative for a given condition, ce toxicity, cost and relative solubility are equally portant to consider.

In otolaryngologic practice, sulfonamide compounds have been applied in sprays, drops and jellies; they have been inhaled as a smoke and insufflated as a powder; they have been used in displacement treatment and, in powdered form, they have been employed for packing wounds. Connell and Trowbridge [4] expressed a preference for powdered sulfathiazole of a 40 to 100 mesh fineness, which would not cake or form hard masses. They found that in acute and chronic rhinitis this powder was "lost more slowly by the passage of excretions back into the pharynx than local preparations instilled into the nose." Apparently ciliary activity was not impaired. Bordley and associates [5] found that the local use of sulfonamide compounds "is soothing to acutely infected mucous membranes, controls the cough," and helps "to control the growth of pyogenic organisms in the upper air passages, and so shorten the period of disability and lessen the incidence of complicating sinus, ear, pharynx and bronchial infections."

Marcotte [6] used sulfanilamide in mastoidectomy wounds and observed healing by first intention with no breaking down of incisions and no stitch abscesses. He complained that ordinary sulfathiazole crystals caked.

Guerry and Putney [7] mentioned that action is displayed solely at the site of use. Absorption is scant, only a trace being found in the blood stream. Livingston [8] also noted less discharge

1. Schenck, H. P.: Use of Sulfanilamide in Otoryngology, Arch. Otolaryng. **28**:698 (Nov.) 1938.

2. Osgood, E. E.: Chemotherapy, Arch. Otolaryng. :961 (June) 1941.

3. Novak, M.: Specific in Vitro Action of Sulfonide Compounds on Pathogenic Organisms, Ann. Otol., hin. & Laryng. **52**:161 (March) 1943.

4. Connell, E. S., and Trowbridge, B. C.: Local Use of Sulfanilamide and Its Derivatives in the Ear, Nose and Throat, Arch. Otolaryng. **35**:740 (May) 1942.

5. Bordley, J. E.; Crowe, S. J.; Dolowitz, D. A., and Pickrell, K. L.: Local Use of the Sulfonamides, Gramicidin (Tyrothricin) and Penicillin in Otolaryngology, Ann. Otol., Rhin. & Laryng. **51**:936 (Dec.) 1942.

6. Marcotte, R. H.: Sulfanilamide Implantation in Mastoid Wounds, Ann. Otol., Rhin. & Laryng. **52**:127 (March) 1943.

7. Guerry, D., and Putney, F. J.: Local Use of Sulfathiazole in Management of Simple Mastoidectomy Wounds, Arch. Otolaryng. **35**:399 (March) 1942.

8. Livingston, G. S.: Sulfonamides in Otolaryngology, Ann. Otol., Rhin. & Laryng. **52**:171 (March) 1943.

but a tendency to caking, while Jones [9] observed that when ordinary sulfathiazole crystals were introduced into wounds of the neck there were formed hardened masses of foreign body reaction. Fenton [10] found the drug valuable but warned against the danger of sensitivity.

Silcox and Schenck [11] discovered that locally applied microcrystals of sulfathiazole compared with similarly applied other sulfonamide compounds offer the advantage of being less irritating and of dissolving more slowly, thus being capable of more prolonged effect. They found that the use of the microcrystals in suspension eliminated the danger of caking and permitted the reaching of interstices inaccessible to dry powders. Blood levels of the drug were uniformly low, demonstrating scant absorption as contrasted with concentrated local action.

These microcrystals of sulfathiazole, which are available as a powder, as a 5 per cent or a 20 per cent suspension in isotonic solution of sodium chloride and as a 5 per cent suspension with 1 per cent paredrine hydrobromide [12] in isotonic solution of sodium chloride, were used in the present study. The last-named preparation satisfies the criteria of p_H and tonicity laid down by Fabricant [13] for solutions for intranasal use.

THE COMMON COLD AND ITS COMPLICATIONS

"The common cold" is a name which has disguised a multitude of pathologic states. In a series of patients observed in a clinic and in private practice an attempt was made to differentiate between two groups which must be segregated in any statistical survey despite the fact that all call their infections "colds." These are:

1. The group with real head colds, whose premonitory symptoms are characterized by a sensation of heat and dryness in the upper respiratory tract, followed by watery coryza and nasal occlusion. Toward the end of the illness there may be some purulent drainage from the sinuses. Any other part of the respiratory tract may also be invaded, either coincidentally or subsequently as a complication, especially in cold weather. But more often the real cold tends to run its course and to clear up even without treatment hence it is not seen with any frequency by the rhinologist. This is the cold which will respond well, especially early, to the papaverine-codeine combination suggested by Diehl.[13a] However since its course is self limited, it provides the raison d'être for a host of proprietary nostrums.

2. The group of people whose first sign of infection is a purulent discharge from the nose or the nasopharynx. Undoubtedly, the fundamental pathologic condition here differs. There may be chronic residual (though latent) infection, flaring up and subsiding from time to time but never disappearing. There may be allergy, bacterial or otherwise. There may be a hereditary weakness or an anatomic abnormality. There may be some other disease lowering vitality. Whatever the basic factor, the hope of spontaneous cure is absent in this group of patients. They need care. Complications in this group tend to be more frequent and more severe but they may be forestalled. My routine of treatment for these patients requires rest in bed and the use of a vasoconstrictor drug in the nose from the outset (contrasted with the routine for the first group, in which shrinking drugs are not used intranasally in the early stages of a cold because of the danger of lessening the blood supply of the infected area). It is felt that the promotion of drainage from infected sinuses is important enough to warrant the use of a mild shrinking agent—the mildest that will give results, since a vasoconstrictor drug which gives skeletal shrinkage permits such a volume of air to pass through the nose that the mucous membranes are dried. Of all the enemies to ciliary action dryness is the foremost (Proetz). A bacteriostatic agent added to the vasoconstrictor drug should lessen the spread of infection to sterile sinuses by controlling infection in the middle meatus and, by its admixture with postnasal discharges, should lessen the incidence of infections of the lower respiratory tract. To determine whether this were so, the aforementioned paredrine hydrobromide–sulfathiazole suspension was used locally in a series of patients, alternate untreated patients serving as controls.

Those patients in this series who had pulmonary symptoms at the onset were excluded, despite of the fact that bronchitis is often caused by sinusitis. (Many a cough which has resisted countless syrups has yielded to treatment of the sinuses.) The patients included in the following tabulations were cooperative and could be followed closely. General treatment consisted of rest, forced intake of fluids and avoidance of chi-

9. Jones, M. F.: Primary Thrombosis of the Common Carotid Artery with Recovery, Ann. Otol., Rhin. & Laryng. **52**:184 (March) 1943.

10. Fenton, R. A.: Local Use of Sulfathiazole in Otolaryngologic Practice, Arch. Otolaryng. **37**:491 (April) 1943.

11. Silcox, L. E., and Schenck, H. P.: Use in Otolaryngology of Drugs of the Sulfanilamide Group, Arch. Otolaryng. **36**:171 (Aug.) 1942.

12. Paredrine hydrobromide is parahydroxy-α-methylphenylethylamine hydrobromide.

13. Fabricant, N. D.: Significance of the p_H of Nasal Secretion in Situ, Arch. Otolaryng. **33**:150 (July) 1941.

13a. Diehl, H. S.: Medicinal Treatment of the Common Cold, J. A. M. A. **101**:2042 (Dec. 23) 1933.

comfort called for local heat; the taking of tylsalicylic acid was permitted when needed; atives were sometimes required because nasal ckage results in wakefulness which in turn ers resistance. Half the patients received the edrine hydrobromide–sulfathiazole suspension the alternates, as controls, received the vaso-strictor drug without the sulfonamide com-nd. Drops were instilled every two hours h the head in either the Proetz or the Parkin-position. (Proper posture is imperative.) e patients were classed as follows:

a) Those who get simple head colds, usually with complication. In 7 of the 48 patients in this group urative ethmoiditis developed, and these 7 are in-ed in group *d*. Forty-one were not treated with athiazole; their records are not pertinent but are tioned because had they been treated the same as group and the results reported with those of that up this would have altered the statistics signifi-ly.

b) Those whose watery colds usually develop into urative sinusitis or bronchitis. Of the 60 in this up, 11 treated with paredrine hydrobromide–sulfa-zole suspension and 6 controls showed no develop-t of pus; 13 treated with the suspension and 8 trols had a scant purulent discharge which cleared hout added therapy; 6 treated with the suspension 16 controls had either sinusitis requiring treatment bronchitis, and in 1 of the latter otitis developed.

c) Patients whose illness included purulent drainage a first symptom. Since the anterior sinuses were lucent, the clinical diagnosis was acute suppurative oiditis, but to most patients there is no difference. rose by any name will smell as sweet!" The im-tance of differentiation lies in the greater tendency ard complication. The following tabulation suggests the local use of sulfathiazole inhibits this tendency.

	Number Relieved and Apparently Cured	Average No. Days of Drainage Without Proetz Displacement	Number Worse, Requiring Displacement Therapy		
			No Bronchitis	Bronchitis	Otitis
ated ents	7	21+	7	4	0
trols	5	25+	4	8	1 (bilateral)

d) Patients treated by Proetz displacement because a purulent discharge. This group offered the only ortunity of trying real local treatment in the sinuses use only by displacement or the use of a cannula medication be applied directly. There were 78 ents, 8 months to 66 years old. None showed cloud-of the frontal sinuses or the antrums at the begin-g of treatment.

	Number Cured	Average Number Days Treated	Bronchitis After Beginning Treatment	Sinusitis Requiring Supplementary Treatment
ated patients	32	10+	7	3
trols.....	14	18+	18	9

Classification of patients with infection of the per respiratory tract is valuable in any consideration of response to therapy. Here the routine use of a bacteriostatic agent would seem to have decreased complications.

SUBACUTE SINUSITIS

Three patients with infection of the frontal sinuses became pain free after the first instillation of the paredrine hydrobromide–sulfathiazole suspension by cannula. (Paredrine hydrobromide was included to keep the ostium patent.) One instillation stopped sinal pus formation in 2; in the third a second application was required.

Two patients with suppurative sphenoiditis had no more pain or purulent discharge after a single instillation of the suspension through the Van Alyea cannula. Another patient required eight treatments.

Fourteen patients with acutely suppurating antrums were treated, 6 with isotonic solution of sodium chloride and 8 with the suspension. In these, the 20 per cent suspension of sulfathiazole was used as long as there was frank pus in the preliminary washing. It was instilled via either the Van Alyea cannula or the Lichtwitz needle biweekly and allowed to remain. Accompanying ethmoiditis, if present, was treated by displacement prior to the antral lavage. The average number of treatments required was two and five-tenths for the sulfathiazole group and four and nine-tenths for the controls. In no case were the crystals found in the washings three or four days later.

CHRONIC MAXILLARY SINUSITIS

Numerous have been the solutions used for antral lavage, but many eminent rhinologists have found nothing superior to saline solution. The antrums, then, offered a good testing field for local sulfathiazole therapy. There were 11 patients whose chronic maxillary sinusitis of one to twenty years' duration had resisted all therapy, including lavage, desensitization, vaccine therapy and irradiation with roentgen rays. Biweekly irrigation was followed by instillation of the 20 per cent suspension of sulfathiazole to fill the sinus. This was continued until no pus had been apparent for two weeks. In 6 patients sinusitis was apparently cured; in 2 it was improved, and in 3, unimproved. The 6 in whom the condition was apparently cured have had no symptoms since treatment was stopped, but presumably their mucosa is such that it will be more liable to reinfection than normal mucosa would be. The 2 whose condition was improved have tended to relapse soon after stopping treatment. One of the

patients whose condition was unimproved submitted to operation. Both antrums were filled with polypoid mucosa, as had been anticipated because of the small volume of suspension which could be instilled before overflow. Postoperative packing with the crystals of sulfathiazole seemed to lessen odor and discharge and to hasten healing with less formation of granulations than usual. (The powder was insufflated biweekly for three weeks.)

REPORT OF A CASE

F. B., a man aged 51, on Jan. 19, 1941 complained of obstruction of the left nostril, postnasal dripping of a yellow exudate and a foul odor to his breath. The symptoms had been constant since his dentist had curetted the socket of his left upper first molar tooth. The tooth had been extracted five years before.

The left antrum was opaque on transillumination. The mucosa in the left nostril was swollen to occlusion; it was very red and bathed in yellow pus. The right nostril was normal. Irrigation of the left antrum brought forth foul-smelling dishwater pus intermingled with curds of deep yellow.

Dr. B. P. Widmann reported all sinuses clear except the left antrum, which showed "a characteristic homogeneous density and haze compatible with disease—exudation and possible hyperplasia." There was "considerable interference with aeration capacity."

Culture of the content showed pneumococci, nonhemolytic streptococci and hemolytic staphylococci (Staphylococcus aureus).

Because his occupation required much traveling, the patient refused even a window operation but was content to have irrigations whenever he was at home. Saline solution, urea, acriflavine and mild protein silver (argyrol) (at his request) plus injections of vaccine and camirol [14] failed to help.

On September 19 the appearance was unchanged. The antrum was irrigated with a 5 per cent solution of sodium sulfathiazole. On September 22 he reported less odor and discharge. This solution was used for irrigations at irregular intervals for almost another year.

On Aug. 3, 1942, the antrum was still opaque, and washings contained much odoriferous pus. Warm air was blown through the cannula, then the sinus was filled with a 20 per cent suspension of microcystals of sulfathiazole. On August 7 the patient said that there had been no drainage and that he felt better than in years. For the first time, washing produced neither pus nor odor. Treatment was repeated on August 14 and 28. Two weeks later the antrum was translucent. In the last year he has had two colds but no sinusitis.

CHRONIC OTITIS MEDIA

An infallible formula for treating patients with chronic otitis media cannot even be hoped for, but the incidence of the condition should lessen with the improvement in therapy of acute infecti The impossibility of learning the degree or kind of pathologic change without opera makes it impossible to promise results from treatment. Not all patients with chronic dis of the ear have cholesteatoma in the ear; n do not even have infection of the mastoid c In almost all there is time for palliative treatm especially if good hearing remains. True, s patients may object to having their ears tre because they hear better when they have a charge, but both Hughson [15] and Pohlman [16] described methods of improving the acuity such patients.

While it manifestly is impossible to rem diseased tissues by the following procedur can see no theoretic objection to it and h seen no harm from it. The mucosa of the audit tube is first shrunken by instillation of a 1 cent solution of neo-synephrine hydrochlor This is blown through a catheter by continu warm air current at low pressure. Five min later a 5 per cent suspension of microcrystal sulfathiazole is instilled through the catheter again forced up by the warm air current. T may be repeated until the crystals are seen in external auditory meatus; one to three eff usually suffice. Silcox and Schenck [11] measu in patients with intact ear drums the amo which could be instilled into the auditory t before there was escape or overflow into throat and found it to be 4 minims (0.25 c However, if the drum is perforated, there is limit to the amount which may be coaxed throu The air current must be the right temperature marked dizziness results. Of course, utm gentleness and certainty of touch are requi Farrior [17] has drawn attention to the dan (among others) of cicatricial narrowing of tube following unskilful manipulation. Rei and Leasure [19] have applied fluid medi through the perforation, exerting pressure in external auditory meatus, but after observing quantity of mucopus which may be pushed i

14. According to the manufacturers (Carroll Dunham Smith Pharmacal Co.), camirol is a specially treated combination of camphor, menthol, iodoform and antimony triiodide in a thin low acid oil vehicle.

15. Hughson, W.: Relief of Deafness in Chroni Infected Ears, Dis. Eye, Ear, Nose & Throat 2 (Sept.) 1942.

16. Pohlman, A. G.: The Diaphragm-Rod Prosth for the Middle Ear, Arch. Otolaryng. **37**:628 (M 1943.

17. Farrior, J. B.: Histopathologic Considerati in Treatment of the Eustachian Tube, Arch. Otolar **37**:609 (May) 1943.

18. Reid, W. O.: Treatment of Otorrhea by Arg Displacement, Brit. M. J. **2**:1271 (Dec. 30) 1939.

19. Leasure, J. K.: Tympanic Cavity Irrigat Ann. Otol., Rhin. & Laryng. **51**:253 (March) 194

external meatus after tubal treatment I am ined to prefer this mode of attack.

f 27 infected ears (23 patients) which had n suppurating from three to forty-eight years, ecame dry in an average of four and eight- hs treatments. Four showed improvement; no improvement. In all, otitis had resisted r methods of attack, and if an infection of middle ear fails to yield to five treatments h sulfathiazole, probably it is wiser to con- r more radical methods.

MASTOIDECTOMY

urrier [20] reported a series of cases in which thiazole was used in the mastoidectomy nd, with controls. In each instance the nd was sprinkled with sulfathiazole and ed. In the control cases the wound was closed a soft rubber drain. The observation was that use of sulfathiazole resulted in less drainage a shorter time, permitting healing by first ntion.

ince closing the simple mastoidectomy wound r filling with the 20 per cent suspension of thiazole, I have found healing to be prompt, nage almost absent, tissue reaction much ced. The wound of the radical mastoidectomy cked with gauze saturated with the same sus- ion. This is left in place for a week, at h time edema and redness are so minimal removal of the pack is facilitated. The fol- up care consists of spraying with the pow- d microcrystals and packing. Granulations kept down, and epithelization seems to be e rapid. I have had no fear of the caking ribed by Livingston or of the foreign body tion which Jones berated, since a reopened nd of the neck in which the microcrystals been implanted was found to be free of them.

MISCELLANEOUS

the tracheotomy wound I have used the sus- ion to saturate the dressing wrapped around base of the cannula and have been impressed the maintained cleanliness of the wound. sulfathiazole apparently acts as a barrier to extension of infection from the trachea into tissues of the neck.

unningham [21] found that sulfapyridine ap- to the tonsillar fossa after operation was not only bacteriostatic but hemostatic. I have slept better when I used a ligature if there was a bleeder. However, the incorporation of the microcrystals of sulfathiazole into the wound clot should lessen the growth of hemolytic organisms and the possibility of solution of the clot with secondary hemorrhage. This seems a sound theory; I have encountered no secondary hemorrhages since using it, but that does not prove its necessity.

After submucous resection, 2 cc. of the 20 per cent suspension can be used to bathe every part of the intermucosal gap without risk of the accumulation of an excess or caking. Postoperative edema is reduced and nasal patency reestablished in one or two days.

In nasopharyngitis of bacterial origin the use of the 5 per cent suspension confers prompt relief. During the winter of 1942-1943 there was an epidemic of sore throats which failed to respond to any medication, local or general. In several of the patients virus pneumonitis developed. Lack of response to the local application of a sulfonamide compound, then, may suggest the possibility of a virus as the etiologic agent.

SENSITIZATION

Concern has been expressed over the increasing local use of the sulfonamide compounds because of the fear of sensitizing the patient and thereby depriving him of the benefit of the drug in more serious infections. However, I believe that in many cases the judicious topical use of these drugs may forestall the need for their oral administration. Should allergy to one member of the group develop, it does not preclude the administration of another. I have observed an allergic reaction to sulfathiazole in 2 of several hundred patients treated. Both patients had received the drug orally some months before until lesions of the skin developed. Its use in the nose was followed by prompt swelling to the point of obstruction. Paredrine hydrobromide without the sulfathiazole relieved the swelling, proving the cause of the latter to be the sulfonamide drug. We have not seen such a sensitizing effect from local use of the preparation. It has been reported, but the many advantages so outweigh the rare reaction that I agree with Key,[22] who judges the routine practice of introducing sulfonamide compounds even into clean operative wounds to be the most important development in surgery since the adoption of rubber gloves.

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Cunningham, B. P.: Clinical and Experimental ies with Sulfapyridine as a Hemostatic Agent, Ann. Rhin. & Laryng. **51**:301 (June) 1942.

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SUMMARY

The local use of microcrystalline sulfathiazole to combat infections of the upper respiratory tract presents the advantages of freedom from mechanical irritation, prolonged action at the site of infection and effective bacteriostatic action.

In a controlled series of cases of subacute suppurative ethmoiditis the instillation of drops or the use of displacement showed that the sulfonamide compound reduced the amount and the duration of the discharge and decreased the incidence of complications. In cases of subacute sinusitis other than ethmoiditis, relief was prompt.

In 8 of 11 cases of chronic maxillary sinusitis this condition was cured or improved by irrigation and filling with the microcrystals.

Twenty-seven chronically suppurating [illegible] were treated with the suspension, blown through the auditory tube; in 5 the condi[illegible] was cured and in 4 improved.

Local use of the microcrystals in opera[illegible] wounds resulted in less drainage and tissue re[illegible] tion and accelerated healing. No foreign b[illegible] reaction was observed.

Local application of sulfonamide compou[illegible] may obviate the necessity of oral administra[illegible] and may constitute conservative and succes[illegible] therapy. However, no chemical therapy ca[illegible] a panacea. Its failure may be further indica[illegible] for surgical treatment.

36 Carpenter Lane.

TREATMENT OF EXTENSIVE CICATRICIAL STENOSIS OF THE LARYNX OR THE TRACHEA

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xtensive cicatricial stenosis of the larynx or upper part of the trachea usually can be ed most successfully by an open operation ugh an incision in the neck; such direct sure permits accurate excision of the thick- scar tissue producing the stricture. In those s in which this precise method of reestablish- the normal dimensions of the laryngeal or tracheal lumen is to be employed, it is dis- ly advantageous to divide the course of treat- t into three separate stages: first, the sur- removal of the cicatrix; second, the me- ical prevention of a tendency toward narrow- or constriction of the newly made lumen r a long period, usually six months), and, l, the plastic closure of the external tracheal ing. The difficulties which arise in the care atients during these three stages of treatment due not to the want of technics which are ble of producing creditable results but to the of a simplified form of treatment with r annoying technical details and fewer opera- phases. Dr. New and I have developed a of therapy which in our experience is com- tively uninvolved, which is agreeable to the nt because it neither causes discomfort nor ires any form of laryngeal examination or ipulation during the prolonged second stage reatment, and which has produced gratifying lts in a high percentage of our cases.

uccess by this or any other method of therapy never be assured unless the three following ors are seriously considered prior to the al treatment of the stenosis: first, an evalua- of the etiologic aspects; second, a determina- of the location, the thickness and the extent he obstruction, and, third, an examination of position of the tracheotomy opening in rela- to the stricture itself.

he inflammatory and neoplastic conditions ch contribute to the formation of a cicatricial osis of the larynx or of the upper part of the trachea are well known and a detailed inventory of them is not essential here. When the stricture is due to a specific granuloma such as tuberculosis, syphilis or blastomycosis, one never can stress too strongly the necessity of postponing treatment until it is certain that these conditions have been completely eradicated. The same may be said of neoplasms, such as papilloma. When attempted too soon, the surgical correction of the stenosis may induce activation of such a pathologic process, thus destroying the desired results of the operation and perhaps producing more serious complications.

Probably no etiologic factors effect a more severe form of stenosis than does traumatic or postirradiation perichondritis of the laryngeal or tracheal cartilages. Not only does perichondritis often produce complete atresia but it also may lead to extensive necrosis and sequestration of the supporting cartilaginous structures of the larynx and the trachea; under the latter circumstances, the difficulties encountered in the repair of a stricture are greatly multiplied.

A preoperative determination of the location and the extent of the cicatricial stenosis of the larynx or the trachea is absolutely essential if satisfactory results are to be obtained. Indirect and direct or suspension laryngoscopy are indispensable diagnostic aids, but additional and often valuable information can be acquired through visualization of the lower end of the stricture by means of mirrors inserted through the tracheotomy opening. These methods of examination combined with roentgenographic studies lead to a proper diagnosis. Lateral roentgenograms, in particular, usually reveal the outline of the obstruction vividly (fig. 1). Moreover, in recent years laryngologists have learned to appreciate more and more the value of larnygeal tomography, which provides one with accurate information regarding the extent and thickness of a stricture.

Our technic of treating extensive cicatricial stenoses of the larynx or the upper part of the trachea cannot be executed successfully unless the tracheotomy opening is situated at least 1 and preferably 2 cm. below the stricture. This is

From the Section on Laryngology, Oral and Plastic gery, Mayo Clinic.
Read at the meeting of the American Academy of thalmology and Otolaryngology, Chicago, Oct. 11,

a matter which should receive thorough consideration before proceeding with the surgical removal of the cicatrix. Fairly frequently one finds that the tracheal cannula, which was inserted to relieve symptoms of obstruction, is located too close to the stricture. Under these circumstances, secondary tracheotomy must be performed in such a manner that the new tracheal opening is located well below the stenosis. If such a change in the level of the tracheal cannula becomes necessary, subsequent treatment of the stricture must be deferred until all of the inflammatory reaction occurring in the soft tissues surrounding the newly prepared opening has completely disappeared.

The plan of therapy to be described in this paper will be considered in three stages, which previously have been mentioned.

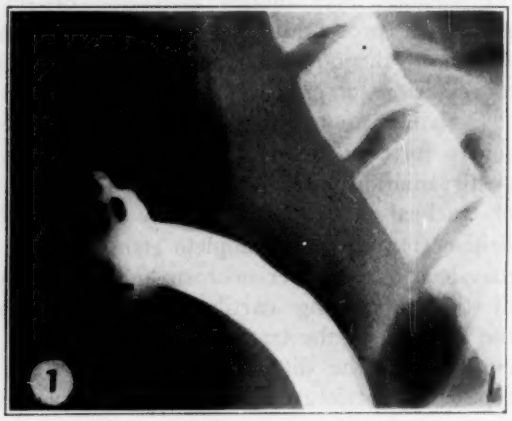

Fig. 1.—Lateral roentgenogram of a subglottic stenosis of the larynx. The constricted lumen is plainly visible just above the tracheal cannula.

FIRST STAGE OF TREATMENT

The surgical exposure of the scar tissue causing cicatricial stenosis of the larynx or the trachea is accomplished with the least amount of difficulty while the patient is under cervical block anesthesia. However, the local infiltration of a solution of procaine hydrochloride will provide effective anesthesia if facilities for performing cervical block are not available. With the patient's head markedly extended, the tracheal cannula removed and his neck draped with sterile towels, a median line incision of the skin is made from the region of the hyoid bone to the tracheal opening. Subsequently, this incision is carried deeper to separate the ribbon muscles in the midline of the neck and to divide the isthmus of the thyroid gland; in many instances, of course, the isthmus previously has been severed during the insertion of the tracheal cannula. When the margins of the wound are retracted, the thyroid, cricoid and upper tracheal cartilages are uncovered. S exposure permits the surgeon to divide t cartilaginous structures in the midline, emp ing for this purpose a scalpel or a motor-dr circular saw, depending on the degree of calci tion of the cartilages in each case. By separa the cut edges of the cartilages, the underl laryngeal mucosa and the cicatrix can be inc in a vertical direction, thus exposing the inte of the larynx and trachea as well as the stricted lumen in the region of the stricture *2a, b* and *c*).

At this stage it is well to apply topically a per cent solution of cocaine hydrochloride inhibit the cough reflex. Thereafter, the tissue producing the obstruction can be ea excised (fig. *2b*). This procedure restores normal dimensions of the laryngeal or the trac lumen in the affected region but leaves a raw face, which Dr. New and I believe should covered with a thin shaved skin graft. Altho many laryngologists do not favor the use of s a skin graft, we are of the opninon that it is tremely beneficial. Such a graft offers a ra method of epithelization for the freshly denu surfaces and thereby greatly shortens the heal period of the wound. Moreover, a skin g tends to reduce the subsequent development scar tissue and, in turn, the tendency tow contracture of the newly formed lumen. buckle [1] was the first to employ intralaryng skin grafts in the treatment of laryngeal steno in recent years, good results attending the use such skin grafts have been discussed in the lite ture, notably by LeJeune and Owens,[2] Neg Foster [4] and Figi.[5]

Dr. New and I prefer to employ a shaved g obtained from the thigh, the arm or the side of thorax; if cut thin, such a graft will heal promp to the underlying raw surfaces in spite of the l grade infection usually occurring in such woun In order to hold the graft against the raw surf within the larynx or the trachea, various for of molds, about which the skin graft is wrapp

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4. Foster, J. H.: The Management of Cicatri Stenosis of the Larynx, Tr. Am. Laryng. A. **61**:1 117, 1939.

5. Figi, F. A.: Chronic Stenosis of the Lary with Special Consideration of Skin Grafting, Ann. Ot Rhin. & Laryng. **49**:394-409 (June) 1940.

been employed. Molds made from rubber ng have been used extensively for this pur-, but we prefer airfoam sponge rubber. A k of sponge rubber about 1 by 1 by 3 inches by 2.5 by 7.6 cm.) can be cut easily and rately with a pair of scissors to form a mold fits snugly within the larynx or the trachea 3*a*). If one wishes, such a mold can be ered with a rubber finger cot. A skin graft, ch should be of generous size, is placed about mold in such a manner that the raw surface he graft is directed away from the mold (fig. The graft completely covers the sponge er mold and is tacked down to the latter in eral places with fine silk thread. Finally, a thorough immobilization of the graft. In this situation, fixation of the mold and graft can be secured by the use of two or three strong retention sutures or wires. Dr. New and I prefer for this purpose heavy silk thread, and we make the stitches horizontally through the mold and the adjacent soft tissues (fig. 2*c*). When the threads are tied, they produce very satisfactory immobilization of the mold and graft. After the skin-covered mold has been seated in the larynx or the trachea and completely immobilized, the margins of the external wound are permitted to fall together and the subcutaneous margins are loosely sutured with catgut and the skin with silk (fig. 3*d*). This step completes the first stage of

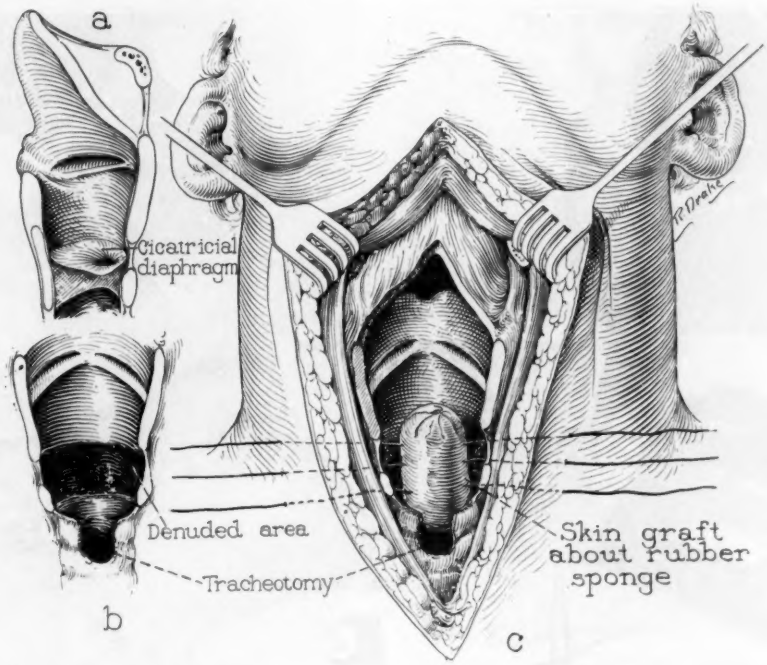


Fig. 2.—Surgical excision of the thickened scar tissue producing a laryngeal or upper tracheal stenosis, with sequent grafting of skin on the resultant raw surface. (*a*) The subglottic stricture. (*b*) The resultant raw face after the surgical excision of the scar tissue. (*c*) The surgical approach through the midline to the interior the larynx and the method of grafting skin on the newly formed lumen. The sponge rubber mold covered with kin graft is visible in the region of the newly formed subglottic lumen. Three silk sutures used for immobili-ion of this mold are visible.

y silk thread is inserted through the skin-ered mold just above its lower end (fig. 3*c*); thread serves as a medium for attaching the d to the tracheal cannula.

After the skin-covered mold has been inserted ough the external tracheal opening into the nx or the upper part of the trachea (fig. 2*c*), tracheal cannula is inserted into the trachea. mediately, the mold is anchored to the tracheal nula by means of the silk thread just de-ibed. Here, as in any other region of the body, cess in grafting skin is greatly dependent on treatment, the skin-covered mold being allowed to remain undisturbed within the larynx or the trachea for a period of ten days.

SECOND STAGE OF TREATMENT

The second stage of treatment involves the construction of an obturator which will maintain the newly made and skin-grafted lumen in the larynx or the trachea until there is no longer danger of contraction of the scar tissue in the walls of these structures. As is well known, any cavity or tract artificially prepared in the body

becomes quickly occluded by scar tissue unless it is held open by some mechanical means. After several months, this tendency toward contracture gradually diminishes until finally the cavity will remain open without artificial aid. In the larynx or the trachea, the length of time that an obturator should be worn is variable; however, a period of six months usually is required.

Laryngeal or tracheal obturators have been constructed from many different types of materials. Most surgeons employ hard rubber tubing or sponge rubber for this purpose. While an obturator of this type does maintain patency of the laryngeal lumen, it has a great many disadvantages. It is likely to elongate, often passing up into the hypopharynx to interfere with swallowing. When elongated, it must be removed and replaced by one of proper size; this procedure is unpleasant to the patient, since direct or suspension laryngoscopy is required for the insertion of a new one. Moreover, rubber obturators stimulate the formation of granulation tissue within the larynx or the trachea as well as a discharge which often has a foul odor. Furthermore, there is great difficulty in maintaining fixation of a rubber obturator in the larynx over a l period; in consequence the obturator is cou out of the larynx fairly frequently. These, t are among the difficulties encountered by la gologists who employ rubber obturators. I do wish to convey the impression that one ca ultimately obtain satisfactory results by t use, but it cannot be denied that their disad tages are often terribly disconcerting to the tient and the surgeon alike.

To overcome these disadvantages, I have veloped a new type of obturator, which is c posed of one of the dental acrylic materials use veronite). These acrylic substances are ployed by dentists in the preparation of artif dentures. Acrylic obturators have a great m advantages over those composed of rubber. T advantages may be listed as follows: 1. They worn with comfort. 2. They never change sh 3. They are so smooth, nonporous and unirrita that they inhibit the formation of granulation sue within the larynx. As a matter of fact, gra lations which may be present at the time the turator is inserted quickly disappear. 4. T produce no discharge and consequently no o

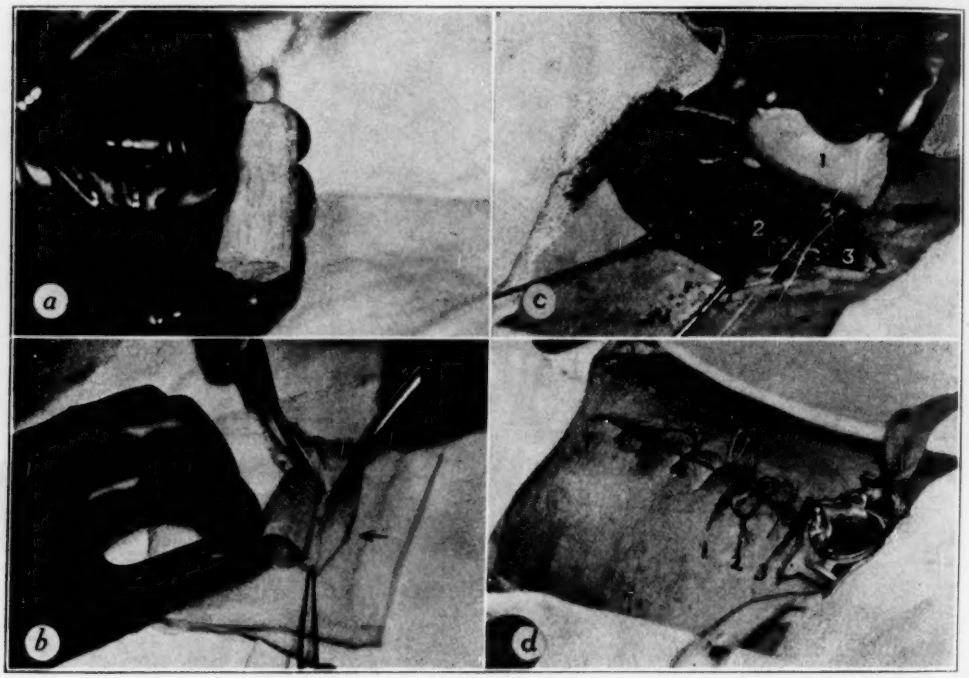


Fig. 3.—(*a*) An airfoam sponge rubber mold, which has been cut to the desired shape with scissors. See ure 2. (*b*) A thin shaved skin graft is being wrapped about the sponge rubber mold. The arrow points to skin graft. (*c*) The sponge rubber mold (*1*) covered with a thin graft is being inserted through the exte incision into the newly formed subglottic lumen (*2*). The double silk thread drawn through the lower en the mold, which anchors this mold to the tracheal cannula later, is visible. The original tracheal openin indicated by *3*. (*d*) The external incision is sutured after the mold has been inserted. The stitches labele *2* and *3* represent the retention sutures for immobilization of the sponge rubber mold. The tracheotomy tub seen in position.

They never require cleansing. 6. They need er be removed during the six month period cicatricial contracture. 7. If an examination the interior of the larynx is desired at any e, the acrylic obturator can be removed ough the tracheotomy opening as an office cedure. This is a distinct advantage because it minates all direct or suspension laryngoscopic minations.

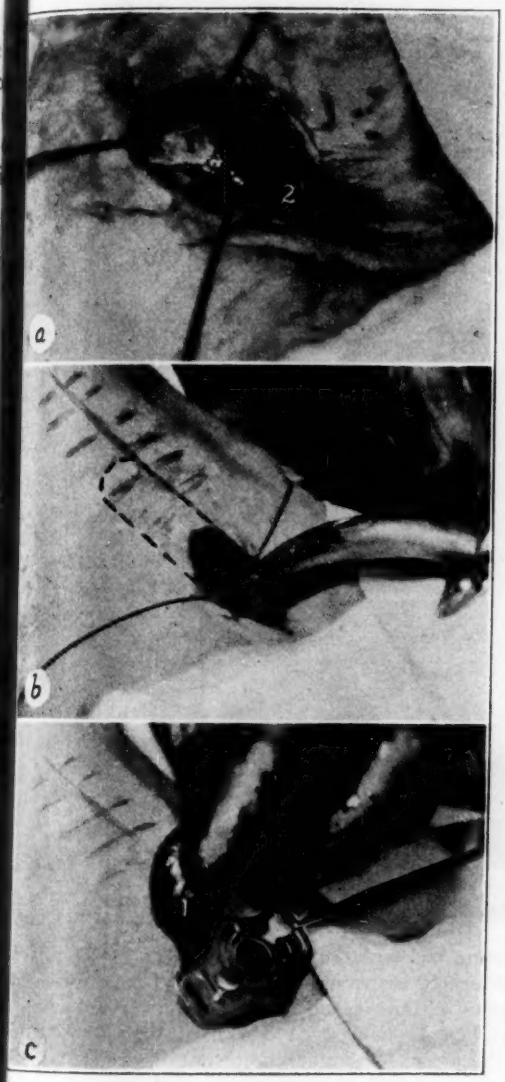


Fig. 4.—(*a*) On the tenth day, the sponge rubber ld, which has been covered with a skin graft, is moved from the external tracheal opening. The skin-afted surface in the region of the newly formed sub-ttic lumen is indicated by *1* and the original tracheal ening by *2*. (*b*) A hard rubber tube has been inserted rough the external tracheal opening into the newly rmed subglottic lumen. This tube forms a part of the del from which an acrylic obturator may be made. rough the lower end of this rubber tube is visible heavy silk suture thread which later anchors the ber tube to the tracheal cannula. The tracheal can-la is being inserted. (*c*) Dental impression compound which has been softened in hot water is being roduced through the external tracheal opening above tracheal cannula down to the rubber tube shown in (*b*).

In our experience, acrylic obturators have greatly simplified the treatment of cicatricial stenosis of the larynx and the trachea. Among the patients for whom we have used such obturators were 2 who lived almost 1,000 miles (1,600 kilometers) from the Mayo Clinic and who were sent home for a period of six months. During this time they did not experience any discomfort from the obturator, even though it was never removed. Furthermore, they never found it necessary to consult a physician during this six month period. If properly constructed, an acrylic obturator which is inserted and removed through the tracheotomy opening can never become displaced or lost and does not require fixation to any structure.

While enumerating the advantages of acrylic obturators, it is well to mention the fact that they have one disadvantage: They necessitate a large tracheal opening. In some cases the resultant tracheal opening cannot be closed by simple approximation of its walls but requires a plastic closure. However, it is our opinion that the numerous advantages of acrylic obturators outweigh this one disadvantage.

The various steps required in the construction of an acrylic obturator are considered among the details in the second stage of treatment of cicatricial stenosis of the larynx or the trachea, which are described in the following paragraphs.

Ten days after the insertion of the skin graft, the three retention threads holding the skin-covered mold in position are removed. In addition, the anchor suture thread around the tracheal cannula is cut, permitting withdrawal of the cannula and the mold from the tracheal opening. Direct and mirror visualization of the interior of the larynx reveals the skin-grafted lumen (fig. 4*a*). If the wound appears satisfactory, one may proceed with the construction of the model for the acrylic obturator. Such a model requires large rubber tubing of approximately the same diameter as the sponge rubber mold, dental impression compound which becomes soft in hot water, and dental base plate wax.

After the topical application of solution of cocaine hydrochloride to the laryngeal mucosa to inhibit the cough reflex, a section of the large rubber tubing is cut to equal the length of the sponge rubber mold. Through the lower end of this tube is inserted a heavy silk thread, which later anchors this rubber tube to the tracheal cannula (fig. 4*b*). The rubber tubing is coated with petrolatum and is introduced in an upward direction through the external tracheal opening into the larynx. If the tracheal opening is not

of sufficient size vertically to permit insertion of the rubber tube, it must be enlarged by an upward incision in the median line. After the rubber tube has been seated within the larynx, the tracheal cannula is inserted (fig. 4*b*). The silk suture thread attached to the rubber tube is then tied around the tracheal cannula for fixation of the tube.

About half a cake of dental impression compound is softened in a pan of hot water. This soft compound is forced into the tracheotomy opening above the tracheal cannula and down to the rubber tube within the larynx and trachea (fig. 4*c*). Later, this plug of impression compound is attached by dental wax to the rubber tube; in the finished obturator, this plug forms a forward extension which protrudes through the tracheal opening (fig. 5*a* and *b*). In addition, it is closely adapted to, and rests on, the tracheal cannula below (fig. 5*b*).

The suture thread anchoring the rubber tube to the tracheal cannula is cut, thus permitting withdrawal of the tracheal cannula, the extension made of dental compound and the rubber t from the neck. The extension and the rubber t are assembled in the same relationship to e other as existed when they were situated wit the larynx and trachea (figs. 5*b* and *c*). Th two structures are made to adhere together w dental base plate wax. This is accomplished melting a small piece of the wax on a dental w spatula or a knife blade, which is held in an op flame (fig. 5*c*). This melted wax then is employ to unite the extension and the rubber tube (5*c*). After the two open ends of the rubber t have been plugged with some dental base pl wax, the model is ready to be sent to a den laboratory for processing in one of the acry materials.

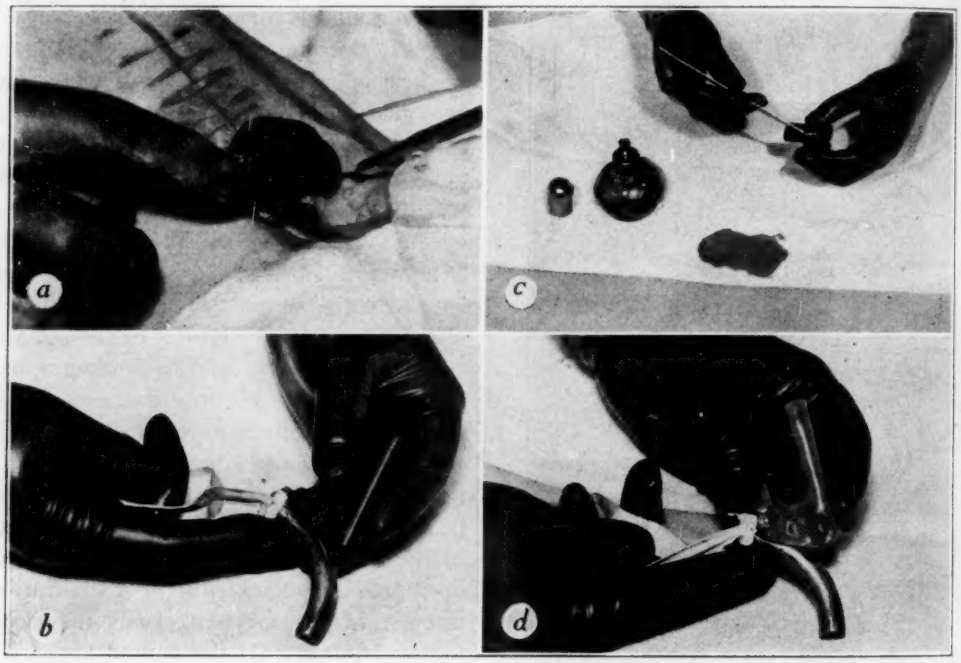


Fig. 5.—(*a*) The tracheal cannula has been removed, exposing the hardened dental impression compound, wh passes through the external tracheal opening down to the rubber tube shown in figure 4 *b*. (*b*) The hard rubber t and the extension made of dental compound, shown in figures 4 *b* and *c* and 5 *a*, have been removed from neck and reassembled in their correct relationship to the tracheal cannula. (*c*) The hard rubber tube and extension made of dental compound, which together form the model for the acrylic obturator, are stuck toget by dental base plate wax. The wax shown in the foreground is melted on a spatula over a flame and is m to flow between the rubber tube and the extension (held in the left hand). This causes these two structures adhere. (*d*) The finished acrylic obturator is shown in its relation to the tracheal cannula. The forward ext sion of the obturator rests on the cannula below and extends outward through the external tracheal openi This extension prevents displacement of the obturator in any direction and obviates the necessity of fixation the obturator to any structure within the larynx or about the neck.

As soon as the model for the acrylic obturat has been completed, the original sponge rubb mold is reinserted into the larynx through t tracheal opening and is anchored to the trach otomy cannula by means of a silk suture. It most essential that this mold be reinserted un the completed acrylic obturator is ready for us

erwise, during the several hours which are uired for construction of the obturator by the tal laboratory, the newly formed lumen within larynx or the trachea would become so con- cted that the introduction of the obturator uld be impossible.

When the acrylic obturator has been finished the dental laboratory (fig. 5*d*), the tracheal nula and the sponge rubber mold are again re-

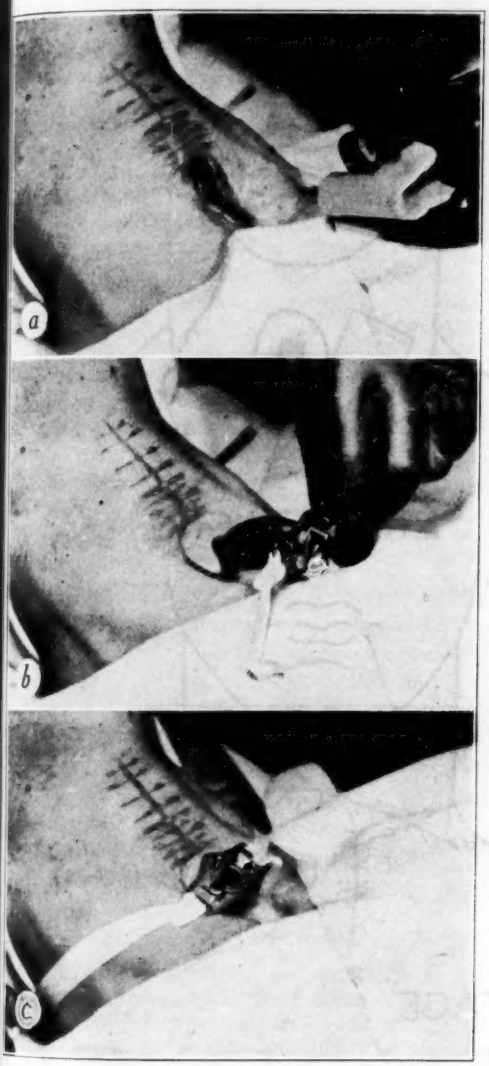


Fig. 6.—(*a*) The finished acrylic obturator is about be inserted through the external tracheal opening into e newly formed and skin-grafted subglottic lumen.) The acrylic obturator is in position and the tracheal nula is being inserted below. (*c*) The acrylic obtu- tor and the tracheal cannula in correct position.

oved from the neck. The obturator is promptly troduced through the tracheotomy opening into e newly formed laryngeal or tracheal lumen ig. 6*a*). Subsequently, the tracheal cannula is serted into the trachea just below the obturator ig. 6*b*). It now becomes apparent why no fixation for the obturator is necessary (fig. 6*c*). The forward extension of the obturator engages the tracheotomy opening, thus preventing any upward or downward displacement of the obturator whether or not the tracheal cannula is in position.

If at this stage it is certain by indirect laryngoscopy that the obturator is of correct length (whether or not the obturator passes between the vocal cords is not important), the patient may be dismissed for six months. If at any time the surgeon wishes to examine the interior of the larynx or the trachea, the tracheal cannula and obturator can be removed through the tracheotomy opening and the examination performed as an office procedure.

THIRD STAGE OF TREATMENT

The third stage of treatment is begun usually six months after the obturator was first inserted, or at a time when it is certain that there will not be any contracture of the walls of the newly formed lumen. This third stage involves merely the closure of the external tracheal opening. As has been stated previously, an acrylic obturator necessitates a large tracheal opening.

If not too large, the opening can be permitted to contract for a period of three or four weeks, at the end of which direct approximation of the lateral margins of the opening can be accomplished by merely freshening the margins and suturing. However, in some cases the diameter of the tracheal opening is too great to permit of this type of closure, and a plastic operation becomes necessary.

Such a plastic procedure must be done in stages. During the first operation, a circular incision is made around the free edge of the tracheal opening and about 2 cm. from it. The skin within this incision is undermined inward for a distance of about 1.5 cm. forming a circular flap of skin which is sutured back in its former position (fig. 7, 1st stage). During the same operation, a ribbon flap of skin is elevated below and to one side of the tracheal opening. This flap is left attached at both ends for a blood supply; after being undermined, it is sutured back in its original bed (fig. 7, first stage).

About two weeks should elapse before one attempts the second operation, which consists in cutting across the superior extremity of the pedicle skin flap and suturing it back in position (fig. 7, second stage). By this procedure the blood supply through the upper pedicle of the flap is severed and this, in turn, induces a physiologic increase of the vascular supply through the lower pedicle.

The third operation is performed two weeks after the second surgical procedure. At this time the circular flap of skin around the tracheal opening is reelevated, folded back on itself and sutured to form a lining for the external tracheal opening (fig. 7, third stage). Subsequently, the pedicle skin flap is completely elevated except for its lower attachment, and is advanced mesially to cover the defect in the region of the tracheal opening (fig. 7, third stage). The skin lateral to this flap is undermined and also stretched mesially to cover the bed of tissue from which the flap was elevated. On completion of this operation, it always is advisable to leave a t opening through which a no. 1 tracheal can can be inserted into the trachea (fig. 7, th stage). Such a cannula provides an additio airway if the normal respiratory tract beco partially obstructed for two or three days crusting on the inner surface of the repai tracheal opening. In addition, the cannula p vents rupture of the reconstructed part, a co plication arising from increased air press within the trachea during coughing. Three four days later the tracheal cannula may be saf removed, leaving the small tracheal opening heal spontaneously.

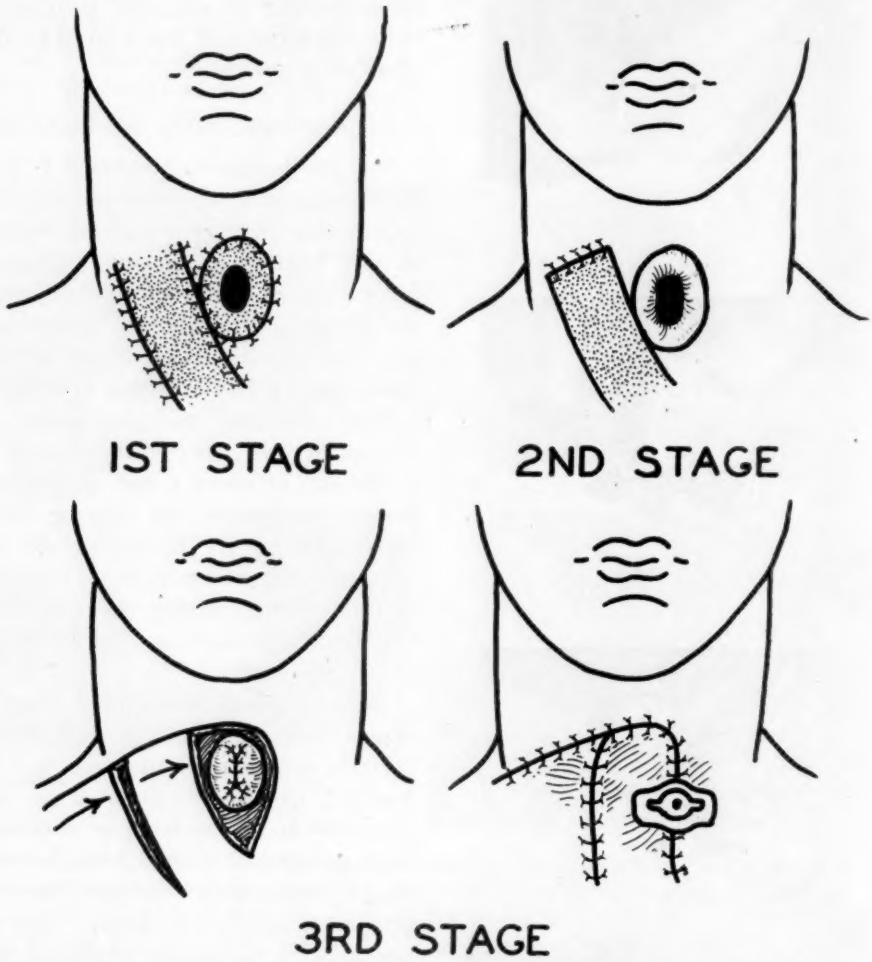


Fig. 7.—*1st stage:* Plastic closure of a large tracheal opening. A circular incision is made around the edge of the tracheal opening and about 2 cm. from it. The skin within this incision is undermined, as is illustrated by the dotted area. This forms a flap, which is sutured back in position. A ribbon flap of skin is elevated below and to one side of the tracheal opening. This flap is left attached at both ends for a blood supply but is completely undermined, as is illustrated by the dotted area. The flap is sutured back in position this stage. *2nd stage:* The superior pedicle of the skin flap is cut across and sutured back in place. severs the blood supply from the upper end of the flap and increases the blood supply from the lower pedi *3rd stage:* The circular flap of skin around the tracheal opening (see *1st stage*) is reelevated, folded back itself and sutured to form a lining for the tracheal opening. The pedicle skin flap is elevated and advan mesially to cover the defect in the region of the tracheal opening. The skin lateral to this flap is undermi and stretched mesially to cover the bed of tissue from which the flap was elevated. A no. 1 tracheal can is inserted into the trachea for a period of three to five days (see text).

Case Reports

OSTEOMYELITIS OF THE SUPERIOR MAXILLA: TREATMENT WITH PENICILLIN

OTTO C. HIRST, M.D., PHILADELPHIA

t is well known that osteomyelitis of any bone he skull is fraught with great danger to life, ndary to extension of the lesion throughout cranium.

n a previous article on osteomyelitis,[1] under heading "Conclusions," the following state- nts were made:

ne may expect any osteomyelitic lesion in the skull over pachymeningitis or to be complicated by an ess of the brain. The first surgical step in the tment of these two frequent complications of osteo- litis is removal of the foci of infection. . . .

he importance of general supportive treatment and sures to increase resistance cannot be overestimated. oday otolaryngologists must add chemotherapy to armamentarium.

still maintain that it is always desirable, en possible, to limit the infection of bone to orignal site. Extensions are often difficult determine in early stages, and consequently the past surgeons have been compelled to ocate radical surgical intervention with wide oval of bone to insure eradication of all cted bone. The resulting deformities have n destructive and never completely corrected plastic surgery. The following pages record ure of osteomyelitis with penicillin and sur- al treatment, and the incidental cure of co- stent chronic purulent frontoethmoiditis with icillin. It is also desired to record the use of enicillin spray in the treatment of a fistula of mouth and the employment of penicillin- urated gauze packs in a sinus, along with the ramuscular injection of the drug.

REPORT OF A CASE

Mr. W. S. C. first consulted me on March 7, 1944. complained of headache, nasal obstruction and a uineous purulent discharge from the left nostril. discharge had been present for three months and been recurrent at intervals for the past ten years. stated that the left maxillary sinus had been lavaged roximately eight years previously and that the re- flow contained pus. Lavage of the antrum done his first visit to me produced approximately 2 chms (7.5 cc.) of a purosanguineous, nonoffensive harge, which mixed with the solution.

he family history was irrelevant; there had been evidence of cancer, allergy or blood dyscrasia. The vious medical history was also irrelevant.

There was tenderness about the left canine fossa and the floor of the left frontal sinus. Examination of the nose revealed a pronounced obstructive high deflection of the septum to the left. Purulent exudate filled the floor of the nose and the middle meatus. The left middle turbinate impinged on the lateral nasal wall, and the septum was in contact with it. The nasal mucosa was over-red and edematous. Postrhinoscopy revealed nothing abnormal except purulent exudate in the left middle meatus, the sphenoethmoid fissure and the floor of the choana. On transillumination the left frontal and left maxillary sinuses were dark and the right frontal and maxillary sinuses clear. The larynx and the ears were normal. The pharynx was normal except for a tonsillar tag in the left fossa and evidence of a partial uvulectomy. Nothing of significance was disclosed by the general physical examination.

A roentgen examination of all nasal accessory sinuses was reported by Dr. A. D. Sampson, of the Hospital of the Protestant Episcopal Church, as follows: "The examination has been carried out with the subject in the erect and in the prone position. It is noted that there is a small quantity of iodized oil in the left antrum consistent with the 5 cc. injected a short time before the examination. Only a trace is present in the left nasal passage anteriorly. By means of this oil it is clearly established that the air space of the left antrum is markedly reduced in size because of thickening or growth of the lining of the antrum.

"The right antrum also shows a similar reduction in its air space, possibly a little greater than that of the left antrum. The cells of the left ethmoid bone are quite hazy, which would indicate that mucosal thickening is present here as well. The cells of the right ethmoid bone are somewhat clearer than those of the left. The frontal sinuses are clouded, but the sphenoid sinus is relatively clear.

"Some difference in the definition of the bony walls is noted in the two antrums. On the right side the bony wall is fairly well defined and undoubtedly is moderately healthy; on the left side the bony wall is less clearly defined and in some points it is difficult to tell where the bone stops and the mucosal proliferation begins. Because of this feature one cannot definitely exclude carcinoma (which has been suspected clinically). Nevertheless, I do not recognize actual destruction of any of the bony substance of the walls of the left antrum and I do not feel that I can make a definite diagnosis of carcinoma of the left antrum. It may be that the entire picture is due to advanced proliferative sinusitis. Therefore, it is my recommendation that before this is definitely accepted or rejected as a case of carcinoma, a biopsy be done."

Lavage of the antrum on April 4 and 11 and May 14 and 29 showed the presence of a purosanguineous discharge. Iodized poppyseed oil 40 per cent was instilled following these lavages with no change in the return flow at the following visits.

The Caldwell-Luc operation was recommended for the left maxillary sinus and performed April 20, 1944.

At operation the mucosa of the sinus was found to be thickened from ¼ to ½ inch (6 to 12 mm.) and

From Otolaryngologic Service "B," Hospital of the otestant Episcopal Church.

1. Hirst, O. C.: Osteomyelitis of the Skull Com- ating Mastoiditis and Frontal Sinusitis, Arch. Oto- ng. **29**:24-38 (Jan.) 1939.

showed polypoid changes. Several small polyps were seen about the ostium. The entire mucosa of the sinus was removed with curets and the use of balls of gauze saturated with a solution of trinitrophenol. The pars membranacea was excised. Bleeding was not unusual, and the sinus was lightly packed with carbozine [2] gauze.

A specimen of mucosa was examined by Dr. W. P. Belk, of the laboratory of the Hospital of the Protestant Episcopal Church, and reported as follows: "Gross description: The material consists of fragments of white tissue. Microscopic description: There is an abundance of tissue for study. The mucosa has been eroded away in most areas. Where present, it is essentially normal. Part of the material is fibrous tissue, heavily infiltrated by lymphocytes and plasma cells. The lesion is chronic, not purulent. A little bone, well moth-eaten, is also present. Pathologic diagnosis: chronic maxillary sinusitis and osteitis."

It is interesting to note the significant conformity of opinion in that the roentgenologist reported that the bony wall of the left maxillary sinus was less clearly defined and in some points it was difficult to ascertain where the bone stopped and the mucosal proliferation began, and the pathologist reported that a diagnosis of chronic osteitis of the superior maxilla could be made.

The medication following operation included ascorbic acid, 25 mg. three times a day, and sulfamerazine 4 Gm., followed by 2 Gm. every two hours. He left the hospital, April 26, in good condition.

April 29, on his first visit after operation, secretion was removed by dry suction, and the sinus and the nasal cavity were "frosted" with sulfanilamide-sulfathiazole powder. May 1 he returned complaining of swelling of the gum about the first upper molar tooth and pain severe enough to interfere with sleep. May 3 he had pain and tenderness about the roof of the mouth, the superior maxilla and the anterior cervical lymph nodes. Sulfadiazine, 2 Gm., followed by 1 Gm. every six hours, was prescribed. May 4 he visited his dentist, who removed the loosened left upper first molar tooth. At the subsequent visit, May 5, the left portion of the palate was still tender, painful and swollen. There was also moderate swelling of the upper and lower eyelids. May 8 the swelling was still present, but there was less pain about the maxilla. May 10 there was increased tenderness about the superior maxilla, extending to the left malar bone. Pain was referred to the region of the left temple and the r margin of the infraorbital rim. His temperatur this time was 99 F. May 15 there was no tende about the left malar bone, but pain was still pr over the superior maxilla and the palate. Swe of the tissues about the superior maxilla and the side of the palate was still present. May 17 his tist removed a sequestrum from the roof of the m through the socket of the first molar tooth. A fi from the mouth to the maxillary sinus was now pre

He was readmitted to the hospital May 18 and g 100,000 units of penicillin intramuscularly each the fistula was sprayed every two hours with a s ture of 1 ounce (30 cc.) of isotonic solution of so chloride and 9,000 units of penicillin, and the was lightly packed twice daily with plain gauze s rated with this same solution. The swelling, redness tenderness of the superior maxilla and the malar b rapidly subsided, and on the fourth day of therapy patient was discharged.

Culture of material from the sinus about the socket produced a growth of a hemolytic type Staphylococcus aureus highly sensitive to penici Culture of material from the maxillary sinus reve the same organism. Culture of material from the revealed Micrococcus catarrhalis predominating, S tococcus viridans (scant growth) and a nonhemo type of Staph. aureus (scant growth). The sulfa zine level in the blood May 16 was 6.6 mg. per dred cubic centimeters. The Kolmer and Kahn were negative and the urine was normal as of May

He visited the office June 2 without compla The fistula had closed, and it was interesting to that there was no discharge in the maxillary s and that it was also absent from the nasal ca There was no tenderness about the left frontoeth region. The nasal mucosa appeared normal for first time. Previous to this examination it was difficult to shrink the mucosa with a saturated s tion of epinephrine hydrochloride and cocaine hy chloride to visualize the region of the middle me Culture of material taken from the left maxillary s through the nasomaxillary opening was reported 14, 1944, as producing no growth.

It is my impression that treatment with p cillin not only materially aided in the cure the osteomyelitis of the superior maxilla eradicated the infection of the frontal and ethm sinuses.

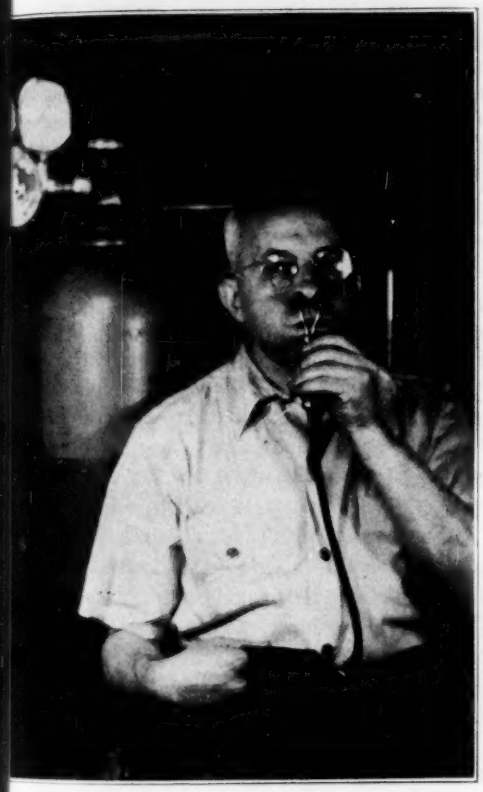
2. Carbozine is 2 per cent phenol in a base consisting of mutton tallow, petrolatum and paraffin.

Clinical Notes; New Instruments and Technics

A NEW METHOD OF TREATMENT FOR NASAL SINUSITIS: OXYGEN INFLATION

MAX UNGER, M.D., NEW YORK

is generally agreed that the functions of the nasal ssory sinuses are (1) lightening of the facial bones, warming and moistening of the inspired air and imparting resonance to the voice. In order to ntain these functions, the sinuses must be properly ted and properly drained, and the mucous membrane t be in healthy condition. When infection of the ses occurs, these conditions change. The mucous brane becomes swollen, the openings of the sinuses closed or obstructed, and aeration and drainage are



Treating sinus infections by oxygen inflation.

rfered with. When medicines are applied locally, main purpose is to shrink the mucosa so that the nings become clear enough for aeration and drainage. n when operation, the last resort of treatment, is loyed, the primary objectives are aeration and drain- Aeration and drainage, therefore, are the great derata.

ll physicians experienced in the treatment of para- al sinusitis dread radical operations. They feel that a radical operation has been done, nothing is left can be done. Since the results of radical operations seldom all that are desired, it is readily seen that method that may establish aeration and drainage through the natural openings and leave the mucosa intact is worthy of a trial at least.

The method I have devised for reestablishing aeration and drainage of the paranasal sinuses is simple in the extreme. Every physician in general practice can use it. All the apparatus needed is a modified Bennett inhaler and a tank of oxygen. The Bennett inhaler is modified so that a flexible tube can be attached to the bottom. The other end of the tube is attached to the outlet of the oxygen control valves. If no Bennett inhaler is available, a fair-sized nasal irrigator tip is used.

The procedure is as follows: First, the physician shrinks the nasal mucosa by spraying it with a vasoconstrictor. Next, he opens the oxygen valve so that the rate of supply valve reads 2 liters per minute. The patient then fits the tips of the Bennett inhaler tightly into his nostrils and inhales. Then he exhales strongly, as though blowing his nose. This raises the air pressure in his nose to about 50 mm. of mercury. If he blows too strongly and the pressure rises to 80 or 90 mm., he inflates his ears, which is unnecessary. He learns to control this quickly, especially if the oxygen tube is connected to a manometer where he can keep his eye on it. No special manometer is needed; the one used for measuring blood pressure serves perfectly. I have proved that this pressure is transmitted into the sinuses in a patient who had an antral fistula in the canine fossa. When a tube was fitted over this opening and connected to a mercury manometer, the oscillations paralleled the oscillations in the manometer connected to the nasal oxygen supply tube.

The mechanics involved are as follows: The vasoconstrictor opens the natural orifices of the sinuses. The rise in intranasal pressure caused by the patient's strong exhalation does two things: First, it helps to shrink the mucosa further by direct pressure; second, it drives the oxygen into the sinuses. The oxygen, entering the sinuses under pressure, hits the farther walls, is deflected around the side walls back to the openings and, when the pressure falls, escapes, carrying the secretions with it. This procedure of alternate inhalation and strong exhalation is kept up for fifteen minutes. When the patient exhales strongly, his face gets flushed, just as it does when he closes his mouth, pinches his nose and puffs out his cheeks strongly to inflate his ears. During oxygen inflations, after a few alternating inhalations and exhalations, he finds it necessary to stop and take a few deep breaths through his mouth. During the forced exhalation, there is, no doubt, a slowing of the cerebral circulation and an increase in the intrapulmonary pressure. After a treatment the patient sometimes says that his "head feels light." I am undecided whether these symptoms indicate general hyperoxygenation due to the increased oxygen in the lungs or cerebral hypoxygenation due to the slowing of the cerebral circulation during the forced exhalation. Further studies will have to be made to determine this.

The patient has to remove the inhaler from his nose occasionally to use his handkerchief to get rid of secretions that accumulate in the nose.

The reasons for the use of oxygen instead of ordinary air are that the oxygen has a stimulating effect on the mucosa and also a deodorizing effect on the bad odor that many patients complain of, especially those with "vacuum sinusitis." After a fifteen minute session the mucous membrane will be found red and well shrunken. It stays that way considerably longer than if it were sprayed only with a vasoconstrictor.

This method of treating sinusitis has been a help with a number of patients, especially those not operated on and those least operated on. A few typical cases will now be described.

REPORT OF CASES

CASE 1.—A woman aged 40 had undergone the Killian operation on both frontal sinuses, the Caldwell-Luc operation on both antrums and complete exenteration of the ethmoid and sphenoid sinuses twenty years before. She complained of continuous dull median headache and purulent nasal discharge. Examination showed all sinuses converted into shallow trenches filled with pus, granulations and scar tissue. She received daily oxygen inflations for thirty days with no effect whatever.

CASE 2.—A woman aged 36 had suffered from sinusitis on the left side for six years. The left antrum had been washed about forty times. She complained of dull frontal headache on the left side, extending back to the middle of the head, and postnasal drip. Examination showed the left middle turbinate swollen, but not obstructively. The mucosa was paler than normal; smears of pus were seen in the middle and superior meatuses on the left. After fifteen minutes of oxygen inflation there was a large amount of pus in each side of the nose. Inflations were given daily. Headache disappeared in one week and pus in three weeks. She was treated for twenty-eight days. There has been no later report of trouble.

CASE 3.—A woman aged 33 gave a history of constant dull ache between the eyes, stuffiness of the nose, muffled nasal voice and frequent head colds. Examination showed all turbinates swollen, the mucosa purple, almost blue, and no pus visible. The mu shrank slowly with the first few treatments, faster l Inflation produced clear glairy fluid. With daily i tions the headache and the discharge cleared u seven days. In two more weeks the mucosa bec red and shrank to normal size, and the patient felt

CASE 4.—A man aged 44 had head colds with a pro thin discharge every three months, in the cours which he was almost prostrated with fever, head malaise and sneezing. After twenty-four hours general symptoms would disappear and the disch become thick and purulent, lasting usually three w About the second week laryngitis would develop. was seen on the third day of the present attack. mucosa was swollen and red, and there was much in both sides of the nose. Daily oxygen inflations five days caused the pus to disappear, and the mu membrane became normal in size and color. Laryn did not develop. This rapid disappearance of pus seen in a number of acute cases of coryza, someti as early as the third day.

CASE 5.—A man aged 38 had frequent frontal h aches on the right side. He had head colds infrequ and used a handkerchief sparingly. Examination sho the right middle turbinate swollen. The mucosa dark red and drier than usual. Typical vacuum sin was present. Oxygen inflation relieved the head after one treatment. Treatments were given for e days. The mucosa became paler and moister, and headache did not recur.

CONCLUSION

Oxygen inflation is of no value when there has extensive destruction of mucous membrane, as see the first case. In other cases it is better than any o method that I have tried. It is worthy of further

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Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

SURVEY OF THE LITERATURE ON TUBERCULOSIS—1940-1943

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ASSISTED BY WILLIAM K. STERN, M.D.*

SARANAC LAKE, N. Y.

This review comprises abstracts of all oto-nolaryngologic articles that were available on subject of tuberculosis for the years 1940 to 43 inclusive.

During this four year period since the last mation in this special field there has been a rth of procurable foreign journals because of war. Consequently, the search has not been haustive, but effort has been made to secure ry possible paper.

The relief of pain in tuberculous laryngitis has eived much attention. The sulfonamide com-nds are being used in the treatment of tuber-ous otitis media but have yet to prove their rth. Further than this nothing striking or chal has been advanced.

BERCULOSIS OF THE EAR AND TEMPORAL BONE

Schwaiger [1] reports the case of a 2 year old who suffered from tuberculosis of the vical lymph glands with caseation and fistula mation. The picture was then complicated by is media on the left, which gave rise to an riferous secretion. The right ear was not cted. A roentgenogram revealed calcification hin the cervical glands on the left side and rgement of the hilar glands. Shortly after-rd the child died of tuberculous meningitis. topsy revealed: caseous tuberculous lesions h calcific deposits in the pneumatic cells of mastoid bone and the roof of the tympanic ity on the left; caseous lymph nodes in the retropharyngeal area, with partial calcifica-n; small caseous and ulcerous lesions in the sils; bilateral hyperplastic tuberculosis of the opharyngeal and submaxillary lymph glands. section of the lungs showed no tuberculous ons. The interpretation was that this child primary tuberculous otitis media with secon-y hematogenous tuberculous meningitis.

Myerson and Gilbert [2] made a comprehensive study of tuberculosis of the middle ear and the mastoid bone, as well as an extensive review of the literature. They state that the primary type of this disease is extremely rare. They believe that in previously reported cases of the primary type the presence of extrapulmonary foci may have been overlooked and that roentgen studies were not available. In past years the use of non-pasteurized milk was a potent factor in the production of tuberculous otitis media with bacilli of the bovine type in infants. Their report of their personal experience concerns 80 patients with tuberculous aural disease observed by them during an eight year period, 24 of whom were proved to suffer from tuberculous otitis media. In 4 of the patients facial paralysis developed. (This symptom was encountered by Turner and Fraser in 45 per cent of their patients with tuberculous otitis. Millgam noted it in 8 per cent, while Leegard and Thompson did not observe it. Amerod had 1 patient with facial paralysis among 26 with otitis media. I have had only 3 patients with facial paralysis over a period of twenty years.) They mention swelling of the periauricular glands but did not observe cervical adenitis.

Roentgen examination proved of little value in the diagnosis.

They insist that when the mastoid bone has become involved to an extent requiring operation, this should be radical and can well be done with the patient under local anesthesia, which lessens shock. Simple mastoidectomy will seldom result in complete healing with cessation of discharge. Indications for operation are mastoid tenderness with profuse aural discharge, especially if these are associated with headache, subperiosteal abscess, facial paralysis, circumscribed labyrinthitis or persistent postauricular fistula after simple mastoidectomy for tuberculous infection. The operation should not be performed

* Fellow of the Trudeau Foundation.

1. Schwaiger, M.: Contribution on the Extrapul-ary Primary Tuberculous Infection in Childhood imary Tuberculous Otitis Media), Ztschr. f. Tuberk. 212-214, 1940.

2. Myerson, M. C., and Gilbert, J. G.: Tuberculosis of the Middle Ear and Mastoids, Arch. Otolaryng. **33**: 231-250 (Feb.) 1941.

in the presence of tuberculous meningitis or general miliary tuberculosis.

Serious complications of the disease may occur if the infection passes through the round window to involve the cochlea or to attack the semicircular canals, causing fistulas of the walls. The disease may extend into the petrous portion of the temporal bone or it may involve the meninges and venous sinuses. The sigmoid sinus and the internal carotid artery are frequently attacked.

Baar and Evans [3] in their introduction survey the medical literature and cite statistical figures showing the considerable incidence of tuberculous otitis media in children; in contrast, its occurrence in adults is rare. Then they discuss the various conceptions of tuberculous otitis media:

1. According to the biologic-anatomic conception of primary tuberculosis ascribed to Ghon and Kudlich, the middle ear is the site of the first tuberculous infection. This theory has been substantiated by Fraser in animal experiments. 2. The middle ear may be the only detectable anatomic localization of tuberculosis; i. e., one has under observation an apparently isolated form of tuberculous otitis media without being able to demonstrate any primary pulmonary focus on necropsy. 3. Tuberculous otitis media may be the first or only clinical sign of tuberculous disease. The patient probably has latent pulmonary tuberculosis without clinical or roentgen pulmonary findings. 4. Tuberculous otitis media may have developed in the primary stage of the pulmonary tuberculous infection (Ranke). 5. After the genetic conception of Ghon and Kudlich, the term "primary tuberculosis" states which tissue within an organ is the first to be affected without regard to any older foci in other organs. 6. Finally Wittmaack calls tuberculous otitis media primary if it occurs in a healthy middle ear and secondary if it develops subsequently to a nonspecific type of otitis media.

In order to avoid the confusion caused by the various contrasting definitions of primary tuberculous otitis media, the authors suggest the use of the comprehensive term "primary tuberculous complex of the middle ear." A short comment on the anatomic changes of the primary complex is made (Ghon focus and ulcerative necrosing form). At the end the authors report a case of primary tuberculosis of the middle ear with necropsy observations, which they claim is the eleventh case to be recorded in medical literature and the first one to be published in England.

3. Baar, H. S., and Evans, R.: Primary Tuberculous Complex of the Middle Ear, J. Laryng. & Otol. **56**:159-175 (May) 1941.

Jaffé [4] states that tuberculous otitis media d not always necessitate surgical interven The disease might present a picture like a or chronic unspecific purulent otitis media might show typical tuberculous lesions on membrane and eventually confluent perfora and even extensive destruction of bone (to the labyrinth and the brain). The gradual p gressive destruction of the labyrinth rarely g rise to the syndrome of true labyrinthitis w vertigo and nystagmus. Frequently one fi more or less decrease of auditory acuteness patients with tuberculosis of the middle The diagnosis is substantiated by culturing purulent drainage for tubercle bacilli or by amining histologically some biopsy material.

Treatment consists in simple or radical m toidectomy according to the patient's gen condition and his pulmonary status. Any s gical intervention is contraindicated in des ate phthisis. The clinician has to decide borderline cases whether surgical treatm might prove beneficial by eliminating the tu culous focus or whether it has to be exclude order not to weaken further an already de tated patient. Simple mastoidectomy gave g results in certain patients with tuberculous m toiditis, especially in children. Frequently berculous involvement can de diagnosed during or after operation. Radical mast ectomy is the logical choice in most case operation is thought advisable.

Goldstein [5] reported the case of a 4 year Negro boy (seen in 1892) who had miliary berculosis of the lungs, with sputum cont ing tubercle bacilli, and a profusely running and facial paralysis. Following mastoidect there were four successive sequestrums, w proved to be exfoliations of the cochlea, the tibule and the semicircular canals. Altho the patient died, there were no meningeal cerebral complications.

Spencer, Whitehead, Black and Duffner [6] fected the middle ears of rabbits with tube bacilli and then treated the animals intraven with sulfapyridine. They were not encour by the results.

Proctor and Lindsay [7] state that tubercul of the temporal bone was described in the e

4. Jaffé, L.: Indications for Surgical Interve in Ear Disease, Prensa méd. argent. **28**:828-834 (A 16) 1941.

5. Goldstein, M. A.: Exfoliation of Cochlea, V bule and Semicircular Canals, Ann. Otol., Rhi Laryng. **50**:574-576 (June) 1941.

6. Spencer, F. R.; Whitehead, R. W.; Black, W and Duffner, G. J.: Chemotherapy of Tuberc Otitis Media, Laryngoscope **51**:773-779 (Aug.) 19

7. Proctor, B., and Lindsay, J. R.: Tuberculosi the Ear, Arch. Otolaryng. **35**:221-249 (Feb.) 194

teenth century by Jean Louis Petit. They rt from the literature that other workers d the incidence of clinically recognizable rculous otitis media in patients with pul- ary tuberculosis to vary from 1 to 13 per , whereas some investigators found that 4.7 l per cent of patients with pulmonary tuber- sis had chronic suppurative otitis media h had not been proved tuberculous. In rculosis of bovine origin the initial lesion occur in the intestinal tract or in the yngeal lymphatic tissues (milk-borne in- ions). Nearly all people become infected tubercle bacilli in childhood or infancy. initial infection is usually in the lungs ex- where milk-borne tuberculosis is still preva-

he overwhelming evidence that aural tubercu- is secondary to a primary focus elsewhere vides the guide to treatment. Attention uld be directed primarily toward improving general condition of the patient. Tubercu- s in the temporal bone rarely threatens life; requently heals spontaneously, and there is e evidence that it has an adverse effect on course of the primary infection. If the gen- condition is good, and if the lesion in the poral bone is the chief active focus in the y, adequate surgical treatment may be indi- d. If poor surgical judgment is used, there danger that an exacerbation of the local or distant focus may be produced inadvertently he surgical procedure. Surgical intervention, well as superimposed infectious processes ch as measles and scarlet fever), may pre- tate miliary dissemination. The extent of surgical procedure is dependent on the ex- t of the disease. An attempt should be made remove the tuberculous focus as completely possible. If the cell system of the middle is involved, a thorough exenteration is re- red.

n summary the authors state that, according statistics, which obviously err on the side of servatism, otitis media has been due to tu- rculosis in less than 3 per cent of all cases ile only 1 to 3 per cent of patients with pul- nary tuberculosis have had otitis media that s diagnosed as tuberculous.

On the other hand, the incidence of supposedly nspecific suppurative otitis media in patients th pulmonary tuberculosis is unusually high 7 to 11 per cent). It is highly probable that many of these patients the otitis media was ginally tuberculous.

A series of cases is presented which illustrate genesis and the character of tuberculosis of temporal bone.

Tuberculosis of the temporal bone usually originates from a blood infection. As with other hematogenous infections, the source of tubercle bacilli is usually a caseous tuberculous focus. This focus is most often a caseous lesion of a primary infection in the lung and hilar lymph nodes or else of a primary infection in the mesenteric or cervical lymph nodes. However, any focus, and above all any active caseous focus (primary or secondary), may be the source from which tubercle bacilli enter the blood stream.

Marrow, including that of the temporal bones, shares with the liver and the spleen the major histiocytic activity of the reticuloendothelial system. Hence, in a sense these tissues act like filter beds for bacteria circulating in the blood stream. As a corollary of this function, in miliary tuberculosis these organs are especially common sites of miliary tubercles. The initial lesion of tuberculosis of the temporal bone occurs as a single focus or more often as multiple foci of miliary tuberculosis in the marrow spaces of the temporal bone or in the mucous membrane of the air spaces of the middle ear or in both. Routine histologic examination of the temporal bones of persons with miliary tuberculosis will reveal a high incidence of foci of miliary tuberculosis. The authors offer histologic evidence to support their contention that healing of tuberculous otitis media may in some cases result in either the formation of cholesteatoma or the development of a chronic adhesive disease of the middle ear.

Cohen and Koepcke [8] survey 140 cases of tuberculous otitis media. The patients were discovered in routine examinations of patients admitted to Glen Lake Sanatorium, Oak Terrace, Minn., during a period of seventeen years. They are classified according to sex, age, unilateral or bilateral involvement and relation of the disease to pulmonary tuberculosis; 138 of the 140 patients had active pulmonary tuberculosis.

After commenting on the extent of the pulmonary disease, the presence of cavitation, the presence of tubercle bacilli in the sputum and the incidence of extrapulmonary tuberculous foci, the authors dedicate several paragraphs to the diagnosis of tuberculosis of the ear. The patient frequently complains of a sense of fulness in the affected ear, increasing loss of hearing, buzzing, ringing, throbbing, humming or crackling and the perception of pulsation. Another early symptom might be aural discharge, first serous and later purulent. While pain is usually absent, its presence does not exclude aural tu-

8. Cohen, S. S., and Koepcke, G. W.: Tuberculosis of the Ear and Mastoid in Adults, Am. Rev. Tuberc. **45**:427-436 (April) 1942.

berculosis. The tympanic membrane might show all the different stages from early infiltration to final perforation or formation of granulation tissue. Hearing tests reveal moderately severe deafness, usually of the obstructive type. The diagnosis might be confirmed by the finding of tubercle bacilli in the discharge and by the results of inoculation of guinea pigs with it or by biopsy of tissue obtained from the middle ear or the mastoid antrum.

Involvement of the mastoid portion of the temporal bone rarely gives rise to specific clinical symptoms, but routine roentgen studies have revealed involvement in 90 of 92 patients with unilateral tuberculosis of the ear and in 11 of 13 with bilateral tuberculous otitis media.

There are differences of opinion about the route of infection, but most authors agree on the way of the eustachian tube and hold that only in a few cases the infection might be hematogenous. Frequently the occurrence of tuberculous otitis media was preceded by a pulmonary hemorrhage.

Complications are comparatively rare. Worth mentioning are meningitis, involvement of the labyrinth, facial paralysis, cerebral abscess of the temporal lobe and occasionally mild vertigo.

As to therapy, of primary importance is the treatment of the pulmonary disease by rest and institutional care. The ear is kept as dry as possible by insufflation of a powder consisting of 25 per cent potassium iodide in boric acid. Administration of ultraviolet rays from the Kromayer lamp and eradication of the mastoid process have also been advocated. Granulations may be cauterized with 25 per cent silver nitrate or removed surgically.

Healing depends on the final outcome of the primary pulmonary disease. It took place in approximately half of the cases in this series. Tuberculosis of the ear might heal with or without permanent perforation of the tympanic membrane, and it is a serious disease as far as the hearing of the patient is concerned. However, it does not affect the prognosis as to life expectancy.

Adams [9] relates that the incidence of tuberculous otitis media after thoracoplasty increased from 0.5 per cent a year for the period from 1934 to 1937 to 4.12 per cent during 1938 to 1939. The increase induced the author to picture once more the syndrome of tuberculous otitis media. The diagnosis is suggested by tinnitus. A feeling of fulness in the ear might occur in the early stage. Pain is exceptional. Otologic exa nation gives first the impression of acute ca rhal otitis media. Repeated examinations weekly intervals are necessary to keep one formed of the tuberculous process, which m lead to perforation of the ear drum and to pairment of hearing. The diagnosis of aural berculosis should be substantiated by a sm of the discharged material. The disease m be divided into three stages: (1) a comparati ly short stage of congestion of the tympanic me brane, (2) a longer one of injection and bulg of the tympanic membrane and (3) a stage watery discharge and desquamation of epitheli ("slush"), which might dry or transform i a purulent discharge and finally lead to sin or multiple perforations. Marked deformi of the tympanic membrane might result if he ing occurs.

The roentgenogram is of value in differenti ing between tuberculous and nonspecific chro otitis media which might lead to nonpneumati tion and sclerosis of the mastoid bone.

As to origin, the author thinks it is doubt that the aural implantation occurs by hemat enous spread and considers the lymphatic ro unlikely too. In the vast majority of cases t secondary tuberculous involvement of the mid ear occurs from the eustachian tube.

He concludes that tuberculous otitis media a complication of pulmonary tuberculosis and i followed thoracoplasty in an increasing numb of patients. A comparison of 10 patients w had tuberculous otitis media after thoracopla with 10 patients who did not have this compli tion after that operation gives evidence that a normal patency of the eustachian tube might considered a predisposing cause of the compli tion. Determining the patency of the eustachi tube is a simple procedure and should be do preoperatively in order that, if necessary, o may try to prevent spread of tuberculosis into t middle ear by insufflation into the eustachian tu of a powder composed of 1 part boric acid and parts salicylic acid.

Côté [10] relates that in from 10 to 20 per c of patients with chronic infection of the ear t ear is tuberculous. However, the condition frequently unrecognized and is often consider to be rare. Aside from the rare primary disea there are three routes by which tuberculo involves the ear:

1. Direct extension via the eustachian tu The patients usually have advanced pulmona tuberculosis and a richly bacillary sputum. T

9. Adams, J. G.: Tuberculous Otitis Media: Complication of Thoracoplasty, Ann. Otol., Rhin. & Laryng. **51**:209-214 (March) 1942.

10. Côté, G. L.: Tuberculosis of Ear, Laval m **5**:452-467 (Dec.) 1940.

ease of the ear may be looked on as a late plication similar to the intestinal and the ngeal disease in these patients. The involvent of the ear comes on insidiously without n and without fever. Frequently, the patient plains only of increasing deafness which is oth the conduction and the nerve type. The airment of hearing is marked, particularly en compared with the apparently slight involent of the middle ear. This is due to the that the petrous pyramid is usually involved, h resulting disease of the labyrinth. Vertigo generally not present; this is a significant ferential point, since pyogenic labyrinthitis ally produces severe vertigo in addition to iness. Examination of the middle ear in most es shows inflammation which is not character- of tuberculosis. Tubercle bacilli are not nd in the aural discharges of the majority of ients. In many patients the disease remains pid, a chronic discharge persists and the deafs becomes complete. In others there is exten- necrotic involvement of bone with various mplications, such as paralysis referable to the th and seventh nerves. General symptomatic atment is indicated, and radical therapy is eless and sometimes dangerous.

2. Extension by the blood stream. There is en evidence of hematogenous involvement elsere in the body. The mastoid bone is commonly ected in patients with this type of aural infecn. Hematogenous aural disease is infrequent. e clinical picture is essentially one of a disease bone rather than of the middle ear as in the st type. Severe pain is characteristic and may present long before there is any evidence of ease of the ear drum. Surgical treatment gives cellent results, provided it is accompanied by equate general measures.

3. Lymphatic extension. This is the most mmon type of tuberculous involvement of the r and is frequently accompanied by secondary fection, making the diagnosis difficult without reful bacteriologic studies. Generally, the ear involved by extension from the lymphatic ssue of the nasopharynx. This type of disease primarily found in infants. Generally, there a preceding acute infection of the nose and e throat in the course of grip or measles. These nesses are often accompanied by tuberculous ergy. Acute otitis media develops and a purut discharge comes on. In contrast to the ual pyogenic infection, the discharge persists r weeks. The infant becomes anemic and has low grade fever; often cervical adenopathy ppears. In such cases, tuberculosis must always considered. The diagnosis is often missed and only becomes clear when another tuberculous manifestation, such as meningitis, supervenes. The patients do well with rest, heliotherapy and sanatorium care. When the disease is recognized early, the incidence of complications, such as tuberculous meningitis, is decreased. Two illustrative case records are cited.

Oreggia [11] gives a bibliographic survey as an introduction. The routes of infection are the blood channel, the lymph channel and, most important of all, the eustachian tube. The morbid anatomy of otomastoiditis includes (1) circumscribed granulomatous lesions, proliferative, productive; (2) diffuse exudative degenerative lesions. Both types are described in detail.

The classifications and clinical forms of infantile otomastoiditis are:

1. Mastoiditis of the primary infection.
   (*a*) Suppurative mastoiditis with coexistent pulmonary lesions.
   (*b*) Primary tuberculous mastoiditis (Collet and Mayoux).
2. Tuberculous mastoiditis of the secondary stage.
   (*a*) Tuberculous exudative osteomyelitis.
   (*b*) Dry necrosing tuberculous otomastoiditis.

Then follow brief discussions of chronic otorrhea, of the diagnosis of tuberculous otomastoiditis, of its course and prognosis and, finally, of the indications for surgical intervention.

There is a relation between the otomastoiditis of children and tuberculous infection far more frequently than is commonly suspected. Before and during the period of primary pulmonary tuberculosis of the infant one has to keep in mind the possibility of the common pyogenous suppurative mastoiditis. Six patients referred to the author for mastoidectomy revealed active primary tuberculosis. A different syndrome important to remember is the primary tuberculous mastoiditis of Collet and Mayoux.

Finally the author describes 7 cases of exudative and 2 cases of dry osteomyelitis of the mastoid bone.

Every child with prolonged purulent otorrhea necessitates a careful investigation for tuberculosis, which should include a family history with the possibility of exposure.

Brahy [12] defines tuberculous otitis as an inflammation of the middle ear with a purulent discharge in which at one time or another tubercle bacilli can be demonstrated. It is a secondary complication of pulmonary tubercu-

11. Oreggia, J. C.: Oto-Mastoiditis of the Infant and Tuberculosis, Arch. de pediat. d. Uruguay **13**:765-779 (Dec.) 1942.

12. Brahy, J.: Tuberculous Otitis, Union méd. du Canada **72**:1184-1185 (Oct.) 1943.

losis and usually occurs by sputogenous spread through the eustachian tube. The onset is insidious, without any characteristic symptoms. There might be a diminution of the auditory acuteness and a feeling of malaise; the tympanic membrane might be thickened and might present a pinkish color on otoscopic examination. The condition is usually discovered by the otolaryngologist at the far advanced stage, often with multiple small perforations. These eventually merge into a large one and provide an outlet for the purulent discharge, thus preventing spread of the tuberculous process to the mastoid process, which is rare indeed. Less unusual are necrosis of the mucous membrane and osteitis of the middle ear, which might give rise to typical signs of involvement of the labyrinth (e. g., vertigo). Finally it might involve the meninges, but the clinical picture of diffuse meningitis is rare. Much more frequently the patients die of the underlying pulmonary disease before all these complications have a chance to develop.

Observations of thousands of patients with pulmonary tuberculosis showed that 15 to 20 per cent have an aural discharge and that in every tenth one the discharge is tuberculous in nature. Tuberculous otitis is five times as frequent in men as in women. It should be kept in mind that one might encounter active chronic tuberculous otitis in a patient whose pulmonary disease is either quiescent or has been healed for some time.

TUBERCULOSIS OF THE NOSE

Fletcher [13] reports 3 cases of nasal tuberculosis. In the first patient, a white woman of 40 years, the left vestibule, the left inferior turbinate and the left side of the septum were involved. Biopsy of the septal tissue showed tuberculosis. Roentgenologically the chest was normal and the bones showed no sarcoid. The lesion was treated by cautery and ultraviolet rays and healed. The second patient was a white woman of 35 years. Tissue removed from infected cells of the ethmoid bones and from the turbinate region showed typical tuberculosis. She had pulmonary involvement, and the nasoethmoid lesion healed normally, slowly. The third patient was a white woman of 30 years who had a small granular mass on each side of the nasal septum. Microscopic sections showed typical tubercles, but the sputum contained no bacilli. A roentgenogram of the chest showed scarring. Those of the bones revealed no lesions. The septal lesions healed after long treatment by rest, cautery and ultraviolet irradiation. He states that syphilis, leprosy, glanders, rhinoscler infected foreign bodies, some forms of cancer other new growths may produce lesions that l like tuberculosis. He considers sarcoid a ph of tuberculosis.

Aliaga and Stutz [14] found a pedunculat tuberculoma the size of a cherry pit attached the anteromedial wall of the right naris i woman 47 years of age who presented obstr tion of the right nasal duct and complained frequent epistaxes. The histologic examinat showed tuberculous granulations with numer epithelioid and giant cells. Two months af resection of the tuberculoma the mucosa show thickening, which disappeared after galva puncture. Five months later, perforation of nasal septum was discovered at the former s of the tuberculoma and mucosal thickening the left side, which was treated by ignipunctu

Specht [15] states that nasal tuberculosis is rare clinical picture. Statistical extraction autopsy reports shows tuberculous lesions of nasal mucosa in 1 to 5 and less per thousa One fourth of the patients were males. T scarcity of nasal infections might be explain by the extraordinary resistance of the na mucosa against infections and by the activity the ciliary epithelium, which together with considerable secretion of the mucosa makes settlement of the tubercle bacilli difficult. T picture of nasal tuberculosis is similar to that any other mucosal tuberculosis; i. e., one m find nodules, small ulcers, tumor-like infiltrati and more extensive ulcerations. To secure exact diagnosis, the physician in general pra tice is advised to make an exploratory excisi The therapy consists mainly in following outline for the treatment of tuberculosis. T author saw good results after the administrati of a gold compound by injection. For the loc ized lesions, diathermy and cautery (snare) a the methods of choice. Furthermore, freezi with solid carbon dioxide, puncture and appli tion of lactic acid may be tried. The final he ing depends on the course of the underlyi pulmonary tuberculous process.

Trenis [16] reminds otolaryngologists that sp tum containing tubercle bacilli might come fr lesions in the pulmonary parenchyma, fr lesions in the tracheobronchial tree or fr lesions in the nasopharynx and it is necessa to differentiate between these three source

13. Fletcher, R.: Chronic Non-Healing Lesions of the Nose, California & West. Med. **52**:62-64 (Feb.) 1940.

14. Aliaga, J. M., and Stutz, C.: Case History Tuberculoma of the Nasal Cavity, Rev. argent. de o rino-laring. **9**:95-98 (March-April) 1940.

15. Specht, F.: Tuberculosis of the Nose, Med. Kl **36**:534-536 (May 17) 1940.

16. Trenis, J. W.: Tuberculosis of the Nasopharyn Am. J. M. Sc. **199**:312-318 (March) 1940.

rticularly specimens showing bacilli in the sence of roentgenograms that do not give idence of pulmonary involvement should cau- the examiner as to the possibility of a tuber- ous infection of the upper respiratory tract.

After quoting the literature on the subject the thor gives 2 case histories, one of which is of rticular interest: The patient was referred th tuberculous cervical adenitis, and clinical vestigation showed sputum containing tubercle cilli in conjunction with a roentgenogram owing a normal chest. On questioning, atten- n was directed to a postnasal discharge which ntained tubercle bacilli as shown by a labora- ry test. Adenoidectomy was performed, and e histologic examination revealed tuberculous enoid tissue. The tuberculous adenitis re- onded well to rest and roentgen treatment. his case emphasizes the importance of careful nical examination of the nasopharynx in the resence of sputum containing bacilli which does t seem to be explained by pulmonary or acheobronchial findings.

Chavanne [17] describes a case of tuberculous steoperiostitis of the nasal bone. The patient as a 37 year old woman who presented a small uctuating tumor at the junction of the nasal ne and the superior maxilla on the left and odular lupus at the middle turbinate on the me side. The anterior part of the septum owed a small tuberculous ulcer. Fistulas veloped at the site of the nasal tumor and in e neck, where on initial examination the cervi- l glands were found to be enlarged. The pa- ent was treated by radiotherapy with the result at there was slight clearing of the ulcer. Then e received 0.5 Gm. tablets of trimethoxydioxy- xotritan (rubrophen)—at the beginning 10, and ter on 6, tablets a day. Altogether she took 00 tablets in a period of six weeks. As a result f the treatment, she showed a gain in weight nd local improvement, evidenced by clearing of he ulcer, closure of the fistulas and regression of he adenopathy.

Aguero [18] observed 9 patients who presented ll the subjective signs of pulmonary tubercu- osis, such as anorexia, fatigue, hoarseness, loss f weight, night sweats, elevation of temperature, ough and expectoration of a material which sually was mucopurulent but at times was lightly blood streaked, though the objective igns were missing; i. e., roentgen examination of the chest, investigation of the sputum and even tuberculin tests gave negative results. The only positive physical signs in these patients were chronic rhinopharyngitis or bronchosinusitis, which at times secondarily gave rise to pulmonary symptoms and simulated tuberculosis. The importance of thorough clinical and roentgenologic examination to exclude pulmonary tuberculosis in such patients is stressed.

Ide [19] states that in spite of the proof that tubercle bacilli have been discovered living saprophytically in the nose, tuberculous lesions of this origin are observed so rarely that he feels compelled to publish a case of what was apparently primary tuberculosis of the nose. Although the condition is extremely rare, the laryngologist should be reminded of its possible occurrence in every case of prolonged and stubborn epistaxis. Every perforation of the septum demands a biopsy to rule out tuberculosis before the obvious diagnosis of trauma is accepted.

Richter [20] reports 2 cases of tuberculosis of the nasal mucosa. The first patient, a 35 year old woman, eight years previous to consultation had a small productive cirrhotic area of tuberculosis at the right apex, which had been quiescent since. She complained of lacrimation and occasional bleeding of the nose. Examination revealed granulations in the anterior portion of both inferior turbinates, which bled easily on touch. Biopsy revealed the tuberculous nature of those granulations with secondary purulent mixed infection. This observation should remind one that secondary tuberculous complication might occur in the upper respiratory tract even if the primary process is of small extent or has been healed for a long time.

The second patient was a 42 year old woman who complained of a purulent discharge from the right nostril. Examination revealed crust-covered granulations with partial necrosis of the anterior portion of the right inferior turbinate. There was no physical or roentgenologic evidence of any pulmonary disease. Biopsy showed typical tuberculous granulations, and the condition was diagnosed as primary tuberculosis of the nose.

The importance of exploratory excision and histologic examination is stressed as sometimes the only means of diagnosing nasal tuberculosis, especially in cases in which nasal findings are not accompanied by any signs of systemic tuberculosis.

17. Chavanne, F.: Tuberculous Osteoperiostitis of the Nasal Bone, Oto-rhino-laryng. internat. **25**:5 (Jan.) 1941.

18. Aguero, A. L.: Nasopharyngeal Pseudotuberculosis, Rev. otorrinolaring. **2**:61 (June) 1942; Am. Rev. Tuberc. **48**:18 (July) 1943.

19. Ide, D.: Tuberculosis of the Nasal Septum, Eye, Ear, Nose & Throat Monthly **22**:225-227 (June) 1943.

20. Richter, H.: Tuberculosis of the Nasal Mucosa with Active or Inactive Pulmonary Findings, Ztschr. f. Hals-, Nasen- u. Ohrenh. **48**:398-400, 1942.

Theissing [21] states that the significance of the upper respiratory tract as a primary site for tuberculous infection is negligible. Specific lesions in the upper respiratory tract are usually a later manifestation of the tuberculous processes manifested by lupus and tuberculosis of the mucosa.

Tuberculosis of the mucosa might consist of superficial infiltration or ulceration and develops usually in persons with open pulmonary tuberculosis contracted by contact infection. This form is usually characterized by pain and rapid course. The secretion of the tuberculous ulcers usually contains tubercle bacilli. If deeper layers are affected by lymphogenous spread, one might find chronic edema and perichondritis and occasionally necrosis and sequestration of the arytenoids and the epiglottis.

Lupus of the mucosa is due to hematogenous spread and is characterized by its chronic course. One sees brownish yellow jelly-like infiltrations in the subepithelial layer, which are fragile on pressure (they might be located on the gingiva, on the soft and the hard palate, the nares, the nasal septum, the epiglottis and the entrance of the larynx). The progressive increase of the granulations and ulceration might lead to perforation of the mucosa and later on to destruction of the cartilaginous and osseous tissue.

A rare form of tuberculosis is the tumor-like granuloma which might occur in the nose and the retronasal pharynx as polypus granulation, on the tonsils as tonsilla pendula and on the epiglottis and the vocal cords as tuberculomas—their specific nature can be proved only by histologic examination.

The main therapeutic feature consists in improving the patient's resistance by general measures, such as institutional care and heliotherapy. In cases of lupus the author obtained good results with a Gerson-Sauerbruch salt-free diet. For local treatment the author recommends freezing with solid carbon dioxide, galvanopuncture, removal with the diathermy snare and electrocoagulation. Furthermore, irradiation with ultraviolet rays from a quartz or carbon arc lamp and occasionally with roentgen rays and radium proved helpful. Other clinicians obtained good results from injections of gold compounds. Dysphagia might be counteracted by injecting alcohol into the superior laryngeal nerve or by resecting the nerve.

21. Theissing, G.: Tuberculosis of the Upper Respiratory Tract and Its Relation to Dentistry, Deutsche zahnarztl. Wchnschr., 1940, pp. 325-332.

TUBERCULOSIS OF THE MOUTH

Collins and Cook [22] reported the case of a year old Irish girl in whom an ulcer, 2 by 3 c on the buccal side of the lower gum to the of the midline was the first manifestation serious extensive tuberculosis. The ulcer of two months' duration. It was shall covered with grayish exudate, indolent and slightly sore. A roentgenogram of the ch showed bilateral apical tuberculosis. Beca of an aural discharge and paralysis of the ternal rectus muscle on the left, the left mast antrum, which was cloudy on the roentgenogr was opened, but no pus was found. The tient had become acutely ill with symptoms meningitis, a diagnosis confirmed on spinal pu ture. The skull was trephined, but the pati died. Autopsy revealed bilateral pulmona tuberculosis, tuberculous meningitis and tub culous ulceration of the mucous membrane of mouth. The oral lesion probably arose fr implantation of tubercle bacilli from the lun

Fitzgerald and Banyai,[23] after some int ductory references to the bibliography, comm on the topical application of cod liver oil. Th report a case, giving the history, the physi findings, the treatment and the results. Th summarize and conclude their observations follows: The striking effect of cod liver therapy in 6 cases together with similar obser tions in 3 other cases of oral tuberculosis duri the past three years seems to signify that natu cod liver oil contains some potent principle th accelerates the healing of tuberculous ulcers the mouth. The therapeutically active fracti of cod liver oil is vitamin A or an unidentifi factor closely associated with this vitamin. T therapeutic results are encouraging and inv further study.

Levina [24] gives observations on 88 patien with far advanced tuberculosis—62.4 per c with bilateral productive cavitary disea Naphthol has an analgesic effect without co trary results and is recommended for the trea ment of tuberculosis of the upper respirato tract. No rationale of the treatment is give

22. Collins, L. H., Jr., and Cook, T. J.: Oral Tub culosis as Initial Manifestation of Rapidly Progressi Fatal Tuberculosis, J. Am. Dent. A. **27**:1608-16 (Oct.) 1940.

23. Fitzgerald, R. J., and Banyai, A. L.: New Tre ment of Oral Tuberculosis, J. Am. Dent. A. **27**:16 1649 (Oct.) 1940.

24. Levina, T. Y.: Experimental Use of Napht in the Treatment of Tuberculosis of the Upper Respi tory Tract, Probl. tuberk., 1940, no. 5, pp. 68-70.

Weiss [25] observed that one of the sites of dilection for localization of oral tuberculosis the gum of the upper jaw. Acute infections the mouth, caries and common dental infec- s are considered as factors predisposing to development of oral tuberculosis. This gs up the importance of careful dental iene in healthy people and tuberculous pa- nts alike, together with routine examinations prompt correction of pathologic conditions the mouth. The diagnosis has to differentiate ween the hypertrophic forms of lupus and coma of the nose, the gums and the jaw. In genesis of oral tuberculosis the importance the intracanalicular, the hematogenous and the phogenous spread are stressed.

Libin and Travushkina [26] observed that the st frequent manifestation of oral tuberculosis an ulcerative lesion of the soft palate. In es of oral tuberculosis in which a primary monary focus cannot be diagnosed, tuber- in tests should be undertaken. The examina- n of autopsy material revealed tuberculosis of soft palate in 5.5 per cent of the cases and erculosis of the lingula mandibulae in 0.9 per t, while histologic examination increased se figures to 17 per cent for tuberculosis of soft palate and 14.2 per cent for tuberculosis the lingula.

Brodsky [27] states that oral tuberculosis is not mmonly observed clinically but is less rare than dinarily presumed. Necropsies of 141 persons o died of tuberculosis revealed tuberculosis of tongue in 28, i. e., 19 per cent. This com- cation can be devastating. As the lesion is ually painful, it interferes with the intake of d and is thus indirectly detrimental to the nu- tional condition and the course of the pul- nary disease of the patient. It usually occurs the far advanced stage of systemic tuberculosis d most frequently by hematogenous spread. e author had occasion to survey a large amount clinical material on the dental service at Sea ew Hospital and noticed that postoperative ection is rare.

Oral tuberculosis might manifest itself in vari- s forms: ulcer, granuloma, tuberculoma, fis- e of the tongue and inflammation such as ssitis. The lesions might be multiple, and they ght show superimposed pyogenic infection. Tuberculous ulcer, tuberculous granuloma, tuberculoma, cold abscess and scrofuloderma are described in detail.

In treatment irradiation with ultraviolet rays, topical cautery and excision have proved rather disappointing. The author recommends the use of grenz rays, which might abort incipient lesions and relieve pain in the more advanced ones. Seven case histories are added, illustrated by excellent photographs.

Merritt [28] comments on the rare occurrence of oral tuberculosis, which is usually a manifestation secondary to systemic involvement. The prognosis is always grave and depends largely on the course of the primary disease, which usually is in an advanced stage when the oral complication becomes evident. To illustrate the importance of histologic examination of every suspicious oral lesion, the author describes a case in which oral tuberculosis was manifested by multiple lesions of granular appearance in the mouth, simulating chronic desquamative gingivitis. Biopsy revealed the specificity of these granulations, and further investigation brought to light that seven years previously the patient had subapical tuberculosis in the left lung with small cavity formation. Death from miliary tuberculosis occurred six months later.

Freudenthal Portas [29] comments on the importance of caries, gingivitis, tonsillar infection and oral pathologic conditions as potential ports of entry for tubercle bacilli and on the necessity of thorough oral examination and treatment of existing oral defects. The frequency and the nature of tuberculous lesions in the mouth are discussed, and a case report is added.

Berberich [30] draws attention to the local treatment of tuberculosis of the mouth by solid carbon dioxide—a method first described by Nussbaum and Teebrügge in 1932. The indications for the treatment are primarily progressive ulcerating lesions and tuberculous granulations in the oral cavity. The more extensive granulomas of the mouth and chronic proliferative tuberculous vegetations respond less well to freezing and then only after preceding curettage. The freezing should be applied as intensively as possible at the first session. It may be repeated after an interval of two weeks and, if necessary, again after another two weeks. Two applications are sufficient as a rule, and it has practically never been necessary

25. Weiss, S. I.: Pathogenesis and Clinical Aspect Tuberculosis of the Oral Cavity, Stomatol. moskva 08, 1941.

26. Libin, S. I., and Travushkina, M. V.: Tubercu- s of the Soft Palate and Lingula, Stomatol. moskva 09, 1941.

27. Brodsky, R. H.: Oral Tuberculous Lesions, Am. Orthodontics (Oral Surg. Sect.) **28**:132-139 (March) 2.

28. Merritt, A. H.: Tuberculosis of the Mouth, Ann. Dent. **1**:26-28 (June) 1942.

29. Freudenthal Portas, A.: The Mouth in Tuberculous Patients, Rev. españ. de tuberc. **11**:556-559 (Sept.) 1942.

30. Berberich, J.: Treatment of Tuberculosis of the Oral Cavity by Carbon Dioxide Snow, Am. Rev. Tuberc. **47**:291-295 (March) 1943.

to freeze more than three times. The lesions heal by scar formation without contraction or distortion. Relapses are uncommon. The treatment itself is painless and simple to perform. The article contains a detailed description of the technic.

In addition to the application of solid carbon dioxide, the author advocates the inhalation of solution of calcium hydroxide U. S. P. in cases of oral tuberculosis with pain and dysphagia—an old treatment of historical significance which had been forgotten for many many years. This method still proves effective for the relief of pain and therefore facilitates the intake of food markedly.

TUBERCULOSIS OF THE TONGUE

Baron and Boyd [31] state that approximately 400 cases of tuberculosis of the tongue have been reported since Morgagni described it in 1761. They feel that this condition is frequently not recognized. They reported a case in which the patient, a man aged 35, had painful cuts on his tongue of three years' duration. A roentgenogram of the chest revealed extensive tuberculosis. The lesion at the tip of the tongue was a circular shallow ulcer with edges somewhat elevated. The outer edge was pale and definitely demarcated from the apparently healthy mucosa; the edge of the ulcer was vague and sloped indefinitely into a shallow gray crater. On the dorsum of the tongue were several deep cracks about ¼ inch (0.64 cm.) in width and varying from ½ to 1 inch (1.27 cm. to 2.5 cm.) in length; they were parallel to the long diameter of the tongue. The sputum contained tubercle bacilli, and the Wassermann test was negative. The patient died of pulmonary disease within two months, with no healing of the tongue. The authors state that the condition occurs most commonly in patients between 40 and 50 years of age, with marked preponderance of male patients. In this case they felt sure of the diagnosis although they were not able to demonstrate the presence of tubercle bacilli in scrapings from the tongue, and permission for biopsy could not be obtained. They think that primary tuberculosis of the tongue must be exceedingly uncommon if it occurs at all.

Farber, Friedland and Jacobs [32] give the histories of 9 patients with tuberculosis of the tongue, which they extracted from records of 190,000 hospital admissions, 9,000 of which were for tuberculosis. It is noteworthy that the di nosis of tuberculosis of the tongue has been m comparatively more frequently in recent ye a fact which should advocate the making o more careful examination of the mouth and throat of the tuberculous patient both in life at the autopsy table.

The authors summarize and comment on t observations as follows: Eight of the 9 pati were men; all of the patients were in the mi decades of life; all of them were white; their cupations did not seem to have any relation their disease; all of them had pulmonary tu culosis, and 5 of them had extrapulmonary tu culous complications. In 2, tuberculosis of tongue was an extension of tuberculosis of jacent structures. All the patients produced s tum containing tubercle bacilli. Trauma jagged carious teeth played an important par causing lingual lesions. Tuberculosis of tongue does not seem to have any site of predi tion. The lesion may start as an eroded indura papule or as a purulent fissure or crevice wi breaks down and forms a typical tubercul ulcer, the floor of which is covered with gra purulent debris. The outstanding clinical sy toms are pain, burning, dysphagia and, sec darily, debility and inanition. Several pati showed increased salivation; spontaneous bl ing is comparatively rare. The final diagn should be verified by biopsy or autopsy. prognosis is poor. The treatment can offer temporary symptomatic relief through top application of anesthetic preparations and lib use of opiates.

Mercandino and Bertelli [33] show by a rev of the literature that tuberculosis of the ton is a rare condition which might be explained the resistance of muscular tissue against tu culous involvement. According to Wesseli, syndrome is fifteen times more frequent in than in women. The spread of tuberculosis i the tongue might occur by the canalicular-he togenous-lymphogenous route and by continu As anatomoclinical lesions they mention ulce tion, tuberculoma, lupus and papillomatous hyp trophic forms, which are described in detail. differential diagnosis should include syph (primary, secondary and tertiary) and cancer

In therapy the established lines for the tr ment of the systemic disease should be c sidered first. For the local involvement authors mention topical applications of coca hydrochloride and nupercaine hydrochloride, radiation with radium or ultraviolet rays, fre

31. Baron, B., and Boyd, L. J.: Tuberculosis of the Tongue, Bull. New York M. Coll., Flower & Fifth Ave. Hosps. **3**:152-154 (Oct.) 1940.

32. Farber, J. E.; Friedland, E., and Jacobs, W. F.: Tuberculosis of the Tongue, Am. Rev. Tuberc. **42**:766-775 (Dec.) 1940.

33. Mercandino, C. P., and Bertelli, J. A.: Tu culosis of Tongue, Rev. Asoc. méd. argent. **55**:13 (Feb. 15-28) 1941.

galvanocautery, applications of chromic or ic acid, zinc chloride, iodides, gold com- nds and chaulmoogra oil. All these remedies briefly mentioned. For the relief of pain the nor recommends resection of the lingual nerve. e personal observation and several case his- es are added.

Koerth, McCorkle and Donaldson [34] report 5 s of tuberculosis of the tongue. All the pa- ts had far advanced pulmonary tuberculosis; ere farmers and 1 was an engineer; the ages ged from 35 to 47. The lesions were (1) a ched-out ragged ulcer on the left margin of tongue, (2) an ulcer at the base of the left erior faucial pillar, extending onto the tongue, a tuberculous erosion of tonsillar crypts and he pillars of the fauces, extending onto the gue, (4) a tuberculous ulcer involving the e of the tongue and the epiglottis (the false al cords and the arytenoids were edematous, the pharynx was injected) and (5) a ragged r on the right margin of the tongue. The dition of 1 patient improved; 3 failed to show provement and 1 died during the time of ob- ration.

The authors believe that the lowering of the eral resistance is a factor in the genesis of ons of the tongue as most of these lesions urred in patients with far advanced pulmonary erculosis. Diminished vitality of tissue is also ctor, as shown by the common occurrence of roken tooth producing mechanical irritation at site of the ulcer. The passage of bacilli-laden tum over the area of lowered resistance un- btedly accounts for implantation infection in e cases. Direct extension by the blood and phatic streams may be responsible for the erculous ulcer at times.

Showing how rarely tuberculosis of the tongue urs, they cited Morrow and Mills, who ob- ed it in only 14 of 14,444 tuberculous patients, ant, who noted it in only 9 of 7,000 patients h far advanced tuberculosis and Martin, who not encounter it once in 7,165 autopsies, al- gh 15 per cent of the subjects were tubercu- s, and who further stated that it was seen three times in 17,251 admissions of tuber- ous patients.

Schugt [35] states that Strandberg found only patients with lingual involvement among 2,000 ents with lupus and that lupus of the tongue more rare than tuberculosis. The differentia- n of the latter from carcinoma of the tongue is important. He says the incipient involvement is usually single but may be multiple. The first painless nodule breaks down to form other nodules or tubercles in the surrounding tissues, producing small ulcers which become deeper. In advanced cases ulceration may involve the entire tip of the tongue; it may be found on the lateral aspect of the tongue and occasionally reaches from tip to base. Pain increases in severity with extension of the lesion. The ulcers are dirty gray or yellow, with secretion in the crypts and little or no induration. Enlargement of the regional lymph nodes is rarely seen, and the tongue remains freely movable—observations which are not true of carcinoma. In discussing treatment the author mentions application of high concentrations of silver nitrate, lactic acid, trichloroacetic acid and methylrosaniline chloride, irradiation with ultraviolet rays (Kromayer lamp), galvanocautery and application of solid carbon dioxide. For severe pain from ulceration involving the side and the tip of the tongue he advises blocking the lingual nerve with 80 to 90 per cent alcohol or resecting it.

For severely painful basal lesions of the tongue he recommends resection of the glossopharyngeal nerve. He says that healing may occur sometimes even in extensive lesions.

Katz's [36] review of the literature revealed only 35 autopsies of patients who died of tuberculosis of the tongue. He states that Portal described the first authentic case of tuberculosis of the tongue in 1804 and that Virchow reported the first case with autopsy in 1864. Katz observed tuberculosis of the tongue in 28 of 141 consecutive autopsies in cases of tuberculosis in which the tongue was examined grossly and microscopically, yielding an incidence of 19.9 per cent. This is in contrast to the reputed incidence of lingual tuberculosis, the literature indicating that it is a small fraction of 1 per cent. There were 35 more autopsies in cases in the hospital records previous to Katz's study, giving a total of 63. Of the patients, 68 per cent were white, 27 per cent Negro, and 5 per cent Asiatic. As 35.3 per cent of persons coming to the autopsy room and 30 per cent of those admitted to the hospital are Negro, the incidence of tuberculosis of the tongue is slightly less frequent in Negroes than in white persons, which also is at variance with impressions gained from the literature.

Of the 63 patients with lingual tuberculosis, 52 (83.8 per cent) had laryngeal involvement. Of the 39 patients with gross lesions of the tongue, 35 (90 per cent) also had gross laryn-

34. Koerth, C. J.; McCorkle, R. G., and Donaldson, M., Jr.: Tuberculosis of the Tongue, M. Rec. **153**: 204-206 (March 19) 1941.

35. Schugt, H. P.: Tuberculosis of the Tongue, Laryngoscope **51**:284-287 (March) 1941.

36. Katz, H. L.: Tuberculosis of the Tongue, Quart. Bull., Sea View Hosp. **6**:239-273 (April) 1941.

geal involvement and 24 revealed involvement microscopically; 16 of the latter group had associated laryngeal disease. Of the 63 patients, 56 (89 per cent) had tubercle bacilli in their sputum, 7 (11 per cent) had no tubercle bacilli in their sputum or only occasionally had these organisms in their sputum or in their gastric contents on concentration or examination. In 54 of the 63 patients with lingual tuberculosis, i. e., in 85 per cent, the author found gastrointestinal tuberculosis.

He viewed the prognosis as bad—worse with lingual than with laryngeal tuberculosis—and the combination of the two as extremely grave.

TUBERCULOSIS OF THE TONSILS AND THE PHARYNX

De Martini [37] tested the growth of tubercle bacilli on ground tissue from tuberculous and nontuberculous human tonsils. He observed that the colonies grew rapidly on the nontuberculous specimens while the material from tuberculous tonsils showed a definite bacteriostatic effect, evidenced by considerable delay of bacillary growth. This bacteriostatic action might account for the rarity with which tubercle bacilli are observed in tonsils with latent tuberculosis.

Hautant [38] reports the case of a 62 year old patient who presented a string of enlarged lymph glands in the left side of the neck and ulceration of the left tonsil. The first diagnosis was that of chronic tonsillitis, but tonsillectomy failed to improve the patient's condition. Subsequent histologic examination of the resected material proved the tonsillar ulceration to be of tuberculous nature. The patient continued to go downhill and died shortly afterward of cachexia. In all likelihood this case represents primary tuberculosis of the tonsils since no evidence of systemic infection was found.

Vívoli and Bertelli [39] reported 80 excised tonsils examined—20 from tuberculous patients and 60 from patients without clinical infection but living with or closely related to persons with active processes. Three of the 20 specimens contained lesions not visible at the examination. The 60 specimens revealed no invasion by tubercle bacilli. One of the patients whose tonsils were infected was a child of 8 years, w is unusual.

Rosencrantz and Hurwitz,[40] before repor their own findings, quote Newhard, who i series of 30,676 tonsillectomies discovered incidence of tuberculosis of the tonsils of appr mately 2 per cent. According to Mullin Wood, the frequency of tuberculous tonsil adults with pulmonary tuberculosis va between 40 and 70 per cent, the majority these patients having far advanced pulmon tuberculosis. The authors observed tubercul of the tonsils in 19 of 103 females with tu culosis, which corresponds to 18 per cent. 19 patients had positive reactions to the M toux test and positive roentgen findings, guinea pig inoculations demonstrated infec with tubercle bacilli in 18 of them. The di nosis of tonsillar tuberculosis was verified microscopic examination of the adenotons tissue after tonsillectomy. In none of the c of tonsillar tuberculosis was the diagnosis m preoperatively, because of lack of clinical dence. The indication for tonsillectomy was same in the tuberculous as in the nontubercul patients. Infection of the tonsils by tube bacilli might occur as a primary exoge infection by inhalation or ingestion or a secondary endogenous infection by hematogen spread or by retrograde lymphatic drainage from the presence of sputum containing bacilli. The authors feel that there is a defi relationship between tuberculosis of the ton and the finding of tubercle bacilli in the gas contents.

Mercandino, López Alcoba and Bertelli [41] cuss a case of oral tuberculosis of the ulce edematous type with involvement of the ton and of the velum palatinum. Because of rarity of this type of tuberculous spread, a view of the literature is added, which is outdated for the present purpose.

Tannhauser [42] reports a case of tubercul of the tonsils and the skin. Histologic evide is presented which indicates primary invol ment of the tonsillar crypts and subsequent involvement by a hematogenous route, w tubercles in the lymph sinuses and germi centers. It is thought that the process proceed from the tonsils as a primary focus through

37. de Martini, R.: Action of Juice of Human Tonsil, Tuberculous and Non-Tuberculous, on Growth of Cultures of Koch's Bacillus, Accad. med., Genova **55**:2-7 (Jan.) 1940.

38. Hautant, A.: Torpid Ulceration of the Tonsil in an Aged Subject with Adenopathy, Presse méd. **48**: 891-892 (Nov. 6-9) 1940.

39. Vívoli, D., and Bertelli, J. A.: Contribution to the Study of Tuberculosis of the Tonsils, An. Cáted. de pat. y clín. tuberc. **2**:193-205 (June) 1940; abstracted, Am. Rev. Tuberc. **44**:69 (Aug.) 1941.

40. Rosencrantz, E., and Hurwitz, S.: Tubercul of the Tonsils, Am. Rev. Tuberc. **43**:388-393 (Ma 1941.

41. Mercandino, C. P.; López Alcoba, H., and telli, J. A.: Consideration of a Case of Ulcero-Ede tous Tuberculosis of Tonsil and of Velum, Rev. A méd. argent. **55**:232-234 (March 15-30) 1941.

42. Tannhauser, S.: Tuberculosis of Tonsils Skin, Am. Rev. Tuberc. **43**:663-669 (May) 1941.

phatics and blood vessels into the hilar nodes, the skin and the lungs and back to the sils.

Further evidence for a possible explanation of origin of the Langhans type of giant cell is icated in the histologic material, which shows intimate relation between many of these giant s and the capillary buds invading the tucles. This relation, the author feels, means truly productive formation of the cells from vessels, which Wurm and Pagel have preusly demonstrated. And these cells are to differentiated from degenerated capillary buds vessels which after fixation and section reible Langhans giant cells by their nuclear angement as well as by the syncytial formans of large mononuclear cells.

Mirande [43] tells of a patient suffering with sphagia for two months whose condition bene worse until he was unable to swallow even own saliva. Oral examination showed alst complete destruction of the left tonsil and tial ulceration of the anterior and posterior cial pillars of the same side, surrounded by rous induration. Microscopic examination reled tuberculosis of the tonsils notwithstandg the fact that no further tuberculous lesion uld be found elsewhere, as in the lungs, the estinal tract or the lymph nodes. Thus the gnosis was primary tonsillar tuberculosis. rgical removal of the lesion and ultraviolet adiation produced healing within two months er the onset of symptoms.

Ribeiro dos Santos [44] discusses (1) the sigficance of the tonsils as a port of entry for the ch bacillus and the subsequent spread of erculosis through the tonsils, (2) the possible uelae of the bacillary invasion of the tonsils,) the problem of reactivation of a quiescent lmonary focus after tonsillectomy and (4) e alleged rarity of primary tuberculosis of the sils. This paper is a purely literary comation with quotations from numerous French thors and theories—all of them outdated and essential for this review.

García Alvarez and Rodríguez [45] report the se of a patient with pulmonary tuberculosis o was treated by pneumothorax and later by interruption of the phrenic nerve. This was followed after an interval of three months by tonsillectomy, which was indicated for chronic hypertrophic tonsillitis with a persistent infection of the upper respiratory tract. Twenty-five days after the tonsillectomy, the patient presented the clinical picture of a systemic hematogenous spread involving all parenchymatous organs and died about three months after tonsillectomy was performed.

Rather [46] introduces his survey with a review of the literature on the genesis of tuberculosis of the tonsils. The spread of tuberculosis infection through the tonsils might be either cryptal—by passage of the tubercle bacilli through the intact or the eroded mucosa at the base of the tonsillar crypts—or follicular, by the hematogenous route, with typical lesions around the follicles and germinal centers. A lymphogenous spread is denied by most pathologists in view of the scanty lymphatic supply of the tonsils. The author's study presents the histologic exploitation of material from about 19,000 patients undergoing tonsillectomy at the Ford Hospital, Detroit, between 1922 and 1941 inclusive, among which he found 35 specimens giving evidence of active tuberculosis of the tonsils. These were classified as follows:

I. Unilateral
  (*a*) Cryptal
    1. Primary (by inhalation and ingestion)
    2. Postprimary (by inhalation or ingestion or raising of sputum containing bacilli)
  (*b*) Follicular (hematogenous)

II. Bilateral
  (*a*) Cryptal
    1. Primary
    2. Postprimary
  (*b*) Follicular

A careful analysis of the histories and the histologic observations revealed that the tonsillar tuberculosis was primary in 18 cases, postprimary (sputogenic) in 7 and follicular in 2; in the rest the nature was uncertain.

The author's presentation is substantiated by numerous case histories, and most of the 35 cases are described in detail. A study of the original is recommended to any one interested in the pathology of tonsillar tuberculosis.

Kravchenko [47] states that tuberculous peritonsillar infiltrations might spread through the oral cavity into the pharynx and to the cervical and submaxillary lymph glands. One might find

43. Mirande, C. M.: Primary Tuberculosis of Tonsils, Rev. otorrinolaring. **1**:91 (March) 1942; abstracted, Am. Rev. Tuberc. **48**:15 (July) 1943.

44. Ribeiro dos Santos: Some Problems of Tuberculosis of the Tonsils, Med. cir. pharm., May 1942, pp. 355-362.

45. García Alvarez and Rodríguez, C.: Fatal Dissemination in a Tuberculous Patient Following Tonsillectomy, Arch. venezol. Soc. de oto-rino-laring., oftal., urol. **3**:136-139 (Sept.) 1942.

46. Rather, L. J.: Tuberculosis of the Tonsils, Am. J. Path. **19**:725-734 (July) 1943.

47. Kravchenko, F. K.: Peritonsillar Infiltrations of a Tuberculous Character; Zhur. ush., nos. i gorl. bolez. **17**:202-203, 1940.

the temperature slightly elevated and the peritonsillar tissue locally infiltrated to a hard consistency, covered by a rather pale mucosa and painless to the touch. In the case reported the patient did not complain of dysphagia. Six or seven weeks later the mucosa acquired a dark cyanotic tint and after another two weeks became pale again and the consistency softer. The recognition of the specific condition was supplemented by histologic examination of biopsy material. Treatment consists mainly of galvanocauterization, which should be undertaken in time; otherwise disintegration of the lesion might follow, with ulceration, pain and dysphagia and subsequent death of the patient of starvation and cachexia.

Monteiro [48] observed primary tuberculosis of the pharynx in a 22 year old man with dysphagia, which became progressively worse over a period of six months. Physical examination revealed granulomatous vegetation on the uvula, which was considerably enlarged at the posterior pillars and the lateral wall of the pharynx, without involvement of the tonsil. Repeated biopsies proved the vegetations to be tuberculous granulomas. The specimens all failed to reveal tubercle bacilli, and the results of guinea pig inoculation proved negative also. Roentgenograms of the chest did not give any evidence of pulmonary tuberculosis. A tuberculin test was positive. The patient received a local application of lactic acid and, temporarily, heliotherapy. He was discharged in the course of treatment, so that its result and the further course could not be followed.

A discussion of the literature on primary pharyngeal tuberculosis preceded the report of this case.

Repetto and Croce,[49] after describing 2 cases of acute miliary tuberculosis of the pharynx and giving the very detailed classification of pharyngeal tuberculosis made by Veuillot, proceed to a detailed academic description of the disease, commenting on the pathologic anatomy, the diagnosis, the clinical course, the prognosis and the treatment. Besides giving numerous prescriptions, they discuss briefly most of the accepted therapeutic procedures, such as spraying, insufflation, topical application, galvanopuncture, electrocauterization, electrocoagulation, alcoholization, injection of the superior laryngeal nerve, ionization with potassium iodide, treatment with gold compounds, roentgen irradiation, actinotherapy and injection of tuberculin. The bet known therapeutic means for providing sym tomatic relief are also considered.

Iglauer [50] presents a carefully written report a case of tuberculous peripharyngeal abscess, contains a detailed description of the topograp of the peripharyngeal space, of the genesis of t abscess in this locality, and finally of the clini course, the clinical determinations and the obse vations at autopsy.

Côté [51] states that tuberculosis of the tonsils more frequent than is commonly expected. Amo 60 patients undergoing tonsillectomy he found with tuberculous involvement of the tonsils—th is, 13.3 per cent. In adults this syndrome is minor importance because it usually occurs as complication of that of far advanced pulmona tuberculosis, which dominates the clinical pictu and course. Tuberculosis of the tonsils is ther fore more significant in children, in whom it o curs either as an involvement secondary to pu monary tuberculosis or as a primary pharynge infection. Only histologic examination can pro the existence of latent tuberculous infection of t tonsils; it therefore should follow every tons lectomy as a routine. This seems of special im portance in cases in which there is coexiste cervical adenopathy, because tuberculosis of t tonsils and tuberculosis of the cervical lymp glands are frequently associated. Every carri of tonsils infected with tubercle bacilli should carefully examined and a roentgenogram mad The surgical removal of tuberculous tonsils do not carry any important risk; on the contrar children usually benefit from tonsillectomy b cause of the removal of this specific focus an the elimination of possible spread.

TUBERCULOSIS OF THE UPPER RESPIRATORY TRACT

Voznesenskiy [52] states that pneumothorax wa beneficial in the majority of patients with tube culosis of the upper respiratory tract and or cavity. The author disapproves of paranephri blockade with procaine hydrochloride becaus the patients tolerate it poorly. Vagosympatheti blockade of the larynx with this drug relieve dysphagia in a number of patients for a limite time, but its indications are limited. The autho

48. Monteiro, A.: Primary Tuberculosis of the Pharynx, Rev. med.-cir. do Brasil **48**:277-292 (May) 1940.

49. Repetto, R. R., and Croce, J. A.: Acute Miliary Tuberculosis of the Pharynx (Isambert's Disease), Semana méd. **1**:157-165 (Jan. 18) 1940.

50. Iglauer, S.: Autopsy Studies of a Case of Tube culous Peripharyngeal Abscess, Laryngoscope **52**:34 352 (May) 1942.

51. Côté, G. L.: Latent Tuberculosis of the Tonsil Laval méd. **8**:161-170 (Feb.) 1943.

52. Voznesenskiy, A. N.: New Studies in the Treat ment of Tuberculosis of the Upper Respiratory Tra and the Oral Cavity, Probl. tuberk., 1940, no. 1, p 70-77.

roduced the method of injecting intracutaously a 0.25 per cent solution of procaine hydroloride in areas of skin adjacent to the laryngeal uctures. This he found particularly helpful in treatment of exudative forms of laryngeal turculosis. It alleviated dysphagia and reduced edematous swelling and secondarily facilitated oductive organization, which made active invention possible (cauterization). In some cases sphagia responds well to iontophoresis with caine hydrochloride. Vibrational massage of neck might be worth trying in cases of incipt or regressive productive infiltration of the al chords. Resection of the glossopharyngeal rve seems indicated only in cases of stubbornly fractory dysphagia which does not respond to other therapeutic measure.

Roentgen irradiation is indicated in productive ffuse tuberculosis of the upper respiratory tract d oral cavity.

At the moment various clinicians are trying jections of gold compounds, but at the time of is publication no definite conclusions have been ached.

In closing the author mentions freezing with lid carbon dioxide, which also has proved effecve in a series of cases.

Voznesensky [53] considers several problematic ints for the control of tuberculosis of the upper spiratory tract, which represents one of the ost serious complications of pulmonary tuberlosis. Unfortunately, in many cases pulmonary berculosis is not recognized until pharyngoryngeal complications set in and even then is equently misjudged and classified as tonsillitis, gina or catarrh before the specific nature is termined. To avoid delay and errors in diagsis the author recommends compulsory postraduate training in otolaryngology for the thisiologist and training in phthisiology for the olaryngologist, and the training of specialists ually versed in both fields. Such training necesitates lectures and demonstrative courses comining both specialties for the initial instruction the medical student and for the postgraduate aining of the specialist.

Belosljud [54] calls asymptomatic forms of tuberlosis of the upper respiratory tract all tuberculous conditions here which produce no subjective mplaints and no vocal changes. Among 139 atients at a sanatorium in Aleksin, Russia, about 25.5 per cent showed an asymptomatic onset and in about 40 per cent the early stages were without clinical objective findings.

Five of the patients showed tuberculous involvement of the pharynx; 4 of the tonsils, 2 of the tongue, 1 of the lip and the palate, 1 of the lip, the soft palate and the uvula, and 121 patients, i. e., the vast majority, had laryngeal tuberculosis.

Among those with laryngeal involvement, 36 had involvement of the vocal cords, 23 of the false cords, 16 of the arytenoids and 23 of the epiglottis. Two patients showed deep ulceration of the cartilage without pain and dysphagia, and 1 patient did not show vocal change in spite of extensive infiltration of one of the vocal cords. Thirty-five per cent began to show symptoms at some time between two days and nine months—the majority of them during the second month.

These sanatorium figures are compared with dispensary figures: The latter show an asymptomatic onset in 15 per cent and an asymptomatic initial period in 38.8 per cent; 61.2 per cent of these patients were men and 38.8 per cent were women.

The patients with advanced laryngeal tuberculosis showed more frequent involvement of the epiglottis, the vocal cords and the false cords than those with the early form.

The discrepancy in the percentage figures of the sanatorium and the dispensary is explained by the early and regularly repeated laryngoscopic examinations in the sanatorium; the dispensary patients frequently came for examination at a more advanced stage of their disease.

Belfort's [55] paper represents an extensive and elaborate review of the bibliography of otolaryngeal tuberculosis, including the classification of cases, the clinical syndrome, statistical extractions and quotations from the literature. It is written in Portuguese and is too lengthy and too difficult to abstract. Furthermore, it is substantially outdated, as it was published in January 1940 and all the bibliographic references are probably known to the American reader through previous reviews. However, it is a good article and should be mentioned here.

Wilson [56] gives an extensive survey of his experience in the treatment of tuberculosis of the upper respiratory tract in over 1,000 patients. The paper includes outlines of the clinical observations on tuberculous laryngitis and tuberculous

53. Voznesensky, A. N.: Early Manifestation of berculosis of the Upper Respiratory Tract, Probl. berk., 1940, no. 5, p. 57.

54. Belosljud, E. G.: Asymptomatic and Early Forms Tuberculosis of the Upper Respiratory Tract, Vestotol., 1940, no. 4-5, pp. 61-66.

55. Belfort, F.: Relation of the Upper Respiratory Tract to Tuberculosis, Rev. paulista de tisiol. **7**:11-50 (Jan.-Feb.) 1941.

56. Wilson, G. E.: Diagnosis and Treatment of Tuberculosis of the Larynx and Contiguous Areas, Arch. Otolaryng. **33**:145-176 (Feb.) 1941.

otitis media, including both the accepted academic descriptions of the syndromes and his own experiences, case histories and statistical extractions, with a consideration of laryngoscopic diagnosis. Numerous literary references are added. This article is reviewed in greater detail under "Tuberculosis of the Larynx," page 85.

Belfort,[57] after emphasizing the importance and the progress of phthisiology as a medical specialty, outlines the role of the otolaryngologist as follows:

1. Diagnosis and local treatment of tuberculous lesions of the ear, the nose and paranasal sinuses and the pharynx.
2. Diagnosis and treatment of laryngeal tuberculosis. Approximately one third of all patients with pulmonary tuberculosis have laryngeal lesions. Any vocal change in a patient with pulmonary disease should urge a prompt laryngeal examination. Among the various treatments of laryngeal tuberculosis, the author mentions briefly cautery, excision, topical applications and irradiation with ultraviolet rays from a quartz lamp.
3. Relief of pain by instillation of oily solutions (chaulmoogra oil).
4. Tonsillectomy, if necessary, to improve general resistance.
5. Bronchography with iodized oil.
6. Tracheotomy for systemic relief in terminal stages.
7. Endoscopy for:
   (*a*) Diagnosis of certain pseudotuberculous hemorrhages.
   (*b*) Differential diagnosis between pulmonary tuberculosis and neoplasm, eventually to be supplemented by biopsy.
   (*c*) Diagnosis of laryngeal tuberculosis.
   (*d*) Differential diagnosis between pulmonary tuberculosis and pulmonary abscess.
   (*e*) Diagnosis of bronchiectasis superimposed on pulmonary tuberculosis, eventually with treatment (drainage, aspiration, topical applications, lavage).
   (*f*) Diagnosis and treatment of bronchial stenosis.
   (*g*) Local treatment of tuberculous lesions, artificial occlusion of bronchus—still in experimental stage.
   (*h*) Endobronchial application of ultraviolet radiation—still being studied.
   (*i*) Endobronchial application of a gold compound—still in experimental stage.
   (*j*) Diagnosis and treatment of lesions in the tracheal and bronchial walls.
   (*k*) Separate examinations of secretions from the right and left bronchi.
   (*l*) Galvanocautery or diathermy coagulation of obstructing lesions.

Hulse[58] emphasizes the role of the otologist in the early recognition of pulmonary tuberculosis. Among the numerous patients consulting the specialist for a common cold, a small percentage might in reality have an acute exudative form of pulmonary tuberculosis, which in its initial stages presents a picture typical of catarrh of the upper respiratory tract, with fatigue, la tude, and irritation of the mucous membra followed by mucoid and purulent secretion. S eral points are stressed for the differentiation the two conditions, such as a careful consid tion of the history, which might reveal inti exposure to tuberculous patients, persis charting of the temperature curve instead o single inconclusive reading, a careful thor examination to elicit the presence or the abs of rales, and a rhinolaryngologic examinati with a short discussion of atrophy of the n mucosa, hoarseness, and weakness and paral of one or both vocal cords. It is understood t the otolaryngologist should be familiar with specific diagnostic means of detecting pulmon tuberculosis, such as thoracic roentgenogra and the examination of sputum, and should e ploy them once his suspicion of the tubercul nature of an infection of upper respiratory t is aroused.

Wilson[59] gives a short clinical description the common tuberculous infections of the up respiratory tract secondary to pulmonary tub culosis, supplemented by prognostic conside tions and his own experience with therape measures gained in private practice. He cla the lowered incidence of recent years is due m ly to collapse therapy of pulmonary tuberculo In the treatment of laryngeal tuberculosis makes extensive use of electrocauterizati which he considers the method of choice moderately advanced and far advanced lesio Injections of alcohol into the superior laryng nerve, tracheotomy and light therapy are c paratively rarely indicated and have shown less satisfactory results than cauterization. symptomatic relief, the common topical appli tions are mentioned.

Searcy, McBurney and Rowe[60] used thym in the treatment of a series of patients for acti mycosis of the jaw and oral tuberculosis, w apparently good results. All the patients show some improvement, and no contrary effects w noted in spite of the toxicity of thymol. Ho ever, in view of the small number of patie treated and the too limited period of therapeu trial (at the time of publication the patients h

57. Belfort, F.: Otolaryngology and Phthisiology, Rev. brasil. de oto-rino-laring **9**:154-157 (March-April) 1941.

58. Hulse, W. F.: Tuberculosis and the Otolar gologist, Arch. Otolaryng. **37**:399-403 (March) 1

59. Wilson, G. E.: Aural, Oral and Laryng Tuberculosis, New York State J. Med. **43**:680 (A 1) 1943.

60. Searcy, H. B.; McBurney, R., and Rowe, H. Thymol Therapy in Tuberculosis, J. M. A. Alaba **11**:217-221 (Jan.) 1942; cited by Spencer, F. Review of Articles on Tuberculosis in Field of O laryngology for Late 1941 and Early 1942, Laryn scope **53**:63-71 (Jan.) 1943.

under treatment for only nine weeks), this lication should be received with reservations.

aimondi and Nijensohn [61] give a short survey he literature on miliary pharyngolaryngeal rculosis (Isambert's disease) and then pre- a case from their own practice. The patient plained of dysphagia and on examination ved disseminated yellow granulations and rations of the pharynx and of the left tonsil faucial pillars. Laryngoscopic examination aled infiltrations and ulcerations of the epi- tis, the vocal cords and the arytenoids. The rculous nature of the lesions was confirmed at psy.

elfort [62] reports that there are three types tuberculosis of the oropharynx: (1) acute ary tuberculosis of the pharynx (Isambert's ase), (2) chronic ulcerative tuberculosis and isolated tuberculosis of the tonsils.

Tuberculosis of the pharynx is uncommon— h rarer than tuberculosis of the larynx. gures based on the author's own observations those of various other authors are given.)

The author discusses briefly the different tes of spread: bronchogenous, intracanalic- , hematogenous, which is the route for mbert's disease, lymphogenous and, finally, ad by continuity from the larynx.

The author is particularly interested in the blem of tuberculosis of the tonsils and raises old questions of primary latent and sapro- tic infections. For the study of this problem outlines the following steps:

Take a certain number of patients.
Test each with tuberculin.
Make a thorough clinical examination.
Take a roentgenogram of the chest.
Examine the sputum and perform gastric lavage, ecessary, to examine the content of the stomach ect smear, culture and guinea pig inoculation).
Aspirate and examine bronchial material for tuber- bacilli.
Do a tonsillectomy if the patient is in a satisfactory sical condition.
Examine the dissected tonsils histologically (sec- s).

This type of study might help in the differen- ion of the following groups: (1) patients with rophytic and latent growth of tubercle bacilli the tonsils, (2) patients with primary tuber- osis of the tonsils, (3) patients with tuber- osis of the tonsils secondary to pulmonary erculosis and (4) patients with secondary contamination of their sputum and gastric contents by bacilli from tuberculous tonsils.

This presentation is substantiated by 11 case histories; no bibliography is added.

Voorsanger [63] states that extrusion of the arytenoids might develop in the course of necrosis of cartilaginous tissue following tuberculous perichondritis which may be considered localized osteomyelitis complicated by the presence of a secondary invading organism (Chevalier Jackson). The cirsoid cartilage is more frequently involved than the arytenoid. The prognosis is usually favorable owing to the fact that cartilaginous tissue is comparatively highly resistant to tubercle bacilli. Perichondritis of the arytenoid cartilages might lead to immobilization of these structures. The diagnosis can be made by palpation and by roentgen examination, which might reveal the changed contours. The condition might be complicated by abscess formation, necrosis of cartilage, extrusion of sequestrated parts, atresia of the laryngeal lumen and development of chondroma. The prognosis might become unfavorable on subsequent progressive stenosis leading to laryngeal obstruction, which sometimes occurs after extensive necrosis of the cartilages with collapse of structural resistance.

A patient with healed tuberculosis of the left lung after two years of pneumothorax treatment was operated on for the removal of a tuberculous left testicle. While convalescing from this operation he began to have a painful throat and experienced difficulty in swallowing, associated with severe coughing attacks. After four days his respiration was almost completely obstructed. He was brought to the sanatorium breathing in stridor. A life-saving tracheotomy was performed. The patient progressed very well but could not swallow solids. After two months he expectorated a mass about the size of the end of the thumb, which on pathologic examination proved to be a bony structure. This mass, which had been observed by roentgen examination prior to tracheotomy, was first thought to be a tuberculoma. Since it was a bony structure, that diagnosis did not hold, and there was presented the problem of deciding what sort of a bony mass could be extruded from the larynx. A series of tomographic roentgenograms proved the mass to be an extruded right arytenoid. The author believes that this is the first time tomographic roentgenograms have been used in this manner to demonstrate laryngeal disease.

61. Raimondi, A., and Nijensohn, M.: Presentation a Case of Miliary Pharyngolaryngeal Tuberculosis ambert's Disease), Arch. argent. de tisiol. **17**:336-339 ly-Sept) 1941.

62. Belfort, F.: Tuberculosis of the Oropharynx, Rev. sil. de oto-rino-laring. **9**:474-479 (Nov.-Dec.) 1941.

63. Voorsanger, W. C.: Arytenoid Extrusion with Roentgenological Studies, Am. Rev. Tuberc. **46**:684-689 (Dec.) 1942.

(To Be Concluded)

Abstracts from Current Literature

Ear

UNILATERAL DEAFNESS. WALTER HUGHSON, Laryngoscope **54**:467 (Sept.) 1944.

Unilateral deafness is important. It decreases efficiency approximately 10 per cent. With this form of deafness it is difficult to determine the direction of a sound. Often there is tinnitus in the deafened ear, which may produce a certain masking effect on the good ear.

In 1,400 cases of hearing loss the defect was found to be unilateral in 9 per cent. The etiologic factors in this 9 per cent were: (1) infection with complications, (2) toxic involvement of the neural mechanism of hearing resulting from acute streptococcic infection of the nasopharynx, (3) direct trauma of the ear or trauma of the acoustic nerve, (4) Ménière's disease, (5) tumor of the acoustic nerve or of the brain, and (6) virus diseases, such as mumps, both the parotitic and the nonparotitic form.

In diagnosing unilateral deafness, a careful history must be recorded. Hereditary deafness is probably not as frequent as might be expected from the patients' statements. Audiograms must be carefully taken, with the better ear appropriately masked. Bone conduction tests are suggestive, but only well done loudness balance tests are conclusive in determining the type of hearing loss. Tests of the labyrinth are often necessary.

The author discusses briefly unilateral deafness resulting from the first five of the six causes mentioned. He goes into some detail concerning that which comes from virus diseases, particularly mumps.

The deafness from mumps is usually unilateral. It sometimes affects the static division of the labyrinth as well. It is irreversible, and no treatment is of value.

It has been observed that some people without having had any symptoms of mumps show the immune reaction characterizing persons who have had mumps. It may be assumed that they have had a subclinical attack. They may have had mumps encephalitis without parotitis. Patients with unilateral deafness of unknown cause may have had this subclinical type of mumps. Complement fixation tests at the time of, and soon after, the loss of hearing would be of value in determining this.

HITSCHLER, Philadelphia.

SYMPOSIUM. THE REHABILITATION OF THE WAR-DEAFENED: I. HISTORICAL AND VETERANS' ASPECTS. GORDON BERRY, Laryngoscope **54**:482 (Sept.) 1944.

Berry tells something of the history of this subject and outlines what happens to the occasional aural casualty who does not find his way into the rehabilitation centers provided but is discharged directly into civilian life. He tells what services are available for those with injuries contracted "in line of duty" or "service-connected" and what services are provided for those whose injuries were not contracted "in line of duty" or not "service-connected." Those with the former sort of injuries are cared for by the Veterans Administration; those with the latter sort, by the Federal Security Agency and the State Vocational Rehabilitation Services.

HITSCHLER, Philadelphia.

SYMPOSIUM. THE REHABILITATION OF THE W
DEAFENED: II. THE REHABILITATION PROGRA
THE NAVY—AURAL CASUALTIES. FRANCIS L.
ERER, Laryngoscope **54**:489 (Sept.) 1944.

Lederer stresses the fact that every effort is ma
enable the men to return at least to limited duty.
Navy's program includes: (1) determination of the
and the degree of the hearing impairment with re
to the amount of serviceable hearing remaining by m
of carefully conducted functional tests and audiom
(2) complete physical examination with special refer
to the upper respiratory tract; (3) ophthalmologic
amination to establish maximum correction of vi
(4) utilization of other departmental facilities as i
cated; (5) psychologic appraisal to establish (*a*) m
ability, (*b*) educational level, (*c*) personality adj
ments, (*d*) abilities or disabilities and (*e*) vocati
interests and aptitudes; (6) instruction in speech
reading; (7) correction of speech; (8) vocational
educational guidance; (9) fitting of a suitable hea
aid when indicated; (10) medical and surgical tr
ment for improvement of the hearing as indicated.

Details of this program are discussed.

HITSCHLER, Philadelphi

SYMPOSIUM. THE REHABILITATION OF THE W
DEAFENED: III. HEARING REHABILITATION
DESHON GENERAL HOSPITAL. E. H. TRUEX
Laryngoscope **54**:496 (Sept.) 1944.

The work being done in the Army is discussed. Th
are separate and distinct services for this work at th
Army hospitals, to which, Truex believes, 10,000
will be admitted in the next two or three years.

The rehabilitation program is discussed under f
headings: (1) purpose, (2) objectives, (3) perso
and equipment and (4) methods.

The results of treatment for the deafness are
encouraging, as most of the subjects have damage
the neural hearing mechanism. One must, therefo
often resort to hearing aids and instruction for
reading. The psychologic aspects of the deafened pe
are important and should not be omitted. Exerc
occupational therapy, recreation and various progr
of teaching all aid. It is hoped that such a progr
will be an example to be followed by both physi
and layman in the future.

HITSCHLER, Philadelphi

SYMPOSIUM. THE REHABILITATION OF THE W
DEAFENED: IV. THE CIVILIAN PROGRAM OF
AMERICAN ACADEMY OF OPHTHALMOLOGY AND O
LARYNGOLOGY. DEAN M. LIERLE, Laryngoscope
506 (Sept.) 1944.

It was found that aural casualties receive adequ
care while in the armed services. Therefore the C
mittee on the Conservation of Hearing of the Ameri
Academy of Ophthalmology and Otolaryngology
direct its attention to those who have left the servi
It is realized that the aid given must be not o
medical but educational, vocational and psychologic.
present there are far too few centers where such c
sideration of the needs is available. The committee

red a manual outlining a program and will appoint representatives who will establish centers for the sary training of those with impaired hearing.
e author gives details of the program and direc- for the organization of these centers.

HITSCHLER, Philadelphia.

Pharynx

RVATIONS ON THE EPIDEMIOLOGY OF STREPTOCOCCAL HARYNGITIS AND THE RELATION OF STREPTOCOCCAL ARRIERS TO THE OCCURRENCE OF OUTBREAKS. ANN KUTTNER and ELMA KRUMWIEDE, J. Clin. Investgation **23**:139 (March) 1944.

ring a six year study of major and minor outks of streptococcic pharyngitis in groups of rheuc children in a sanatorium the following observawere made: Major outbreaks were due to group A lytic streptococci of a single type not previously nt and were not preceded by a rise in the carrier minor outbreaks were preceded by a slow spread e organisms from carriers to other persons without ion at first; sporadic infections were contracted tly from carriers and were not preceded by a disnation of the streptococci to healthy persons.
e following observations were made with regard to arrier state: Twenty-nine per cent of the children tted during the summer and fall months were ers of group A hemolytic streptococci, but with exceptions these micro-organisms did not spread to persons and disappeared after a few months; the mic-inducing types of streptococci persisted longer ostinfection" than in "contact" carriers; the durof the carrier state was not related to the presence e absence of tonsils.

GUEST, Cincinnati. [AM. J. DIS. CHILD.]

STUDY OF THE MECHANISM OF VELOPHARYNGEAL LOSURE. ROBERT HARRINGTON, J. Speech Disorders :325, 1944.

tailed dissections of the soft palates and pharynges 0 cadavers were undertaken. The purpose was to pt to investigate the palatal origin of the pterygryngeus muscle. The palatopharyngeus and salpingryngeus muscles were also studied. In 8 of 10 cases latal origin of the pterygopharyngeus muscle was d. In the majority of cases this bundle consisted of all strand of fibers which originated near the inon of the levator palati muscle in the palatal eurosis. In all cases a hamular origin of the gopharyngeus muscle was found. The hamular n was the better developed and was just inferior e smaller palatal origin. In 8 of 10 cases there muscle connections between the pterygopharyngeus the palatopharyngeus muscle. It was observed that is considerable variability in the general muscular lopment in this anatomic region. The results of study suggest the following conclusions: 1. In addito their hamular divisions, the pterygopharyngei found to receive fibers which originate in the soft e. 2. The palatal fibers of the pterygopharyngei may ribute to mesial movement of the pharyngeal walls g velopharyngeal closure. 3. Muscular connections een the palatopharyngeus and the pterygopharyns muscle normally exist. 4. Because of these conions, the approximation of the palatopharyngei durelopharyngeal closure may contribute to the mesial ement of the lateral pharyngeal walls. 5. In addition eir insertions into the lateral pharyngeal walls, the salpingopharyngeus muscles may occasionally send fibers to the soft palate. 6. The salpingopharyngeus muscles may contribute to velopharyngeal closure by creating an in-bulging of the lateral pharyngeal walls. They may also contribute slightly to the elevating of the soft palate.

Four subjects with cleft palate and 1 subject who had undergone radical resection of a carcinoma of the left maxillary sinus were studied for movement of the velum by roentgen and other methods. The general conclusions from both the anatomic and the physiologic studies are as follows: 1. Palatal fibers of the superior constrictor pharyngeus muscle typically do exist and probably account for a part of the anterior and mesial movements of the pharyngeal walls. 2. Muscular connections between the palatopharyngei and the pterygopharyngei typically do exist and may account for some of the mesial movement of the pharyngeal walls. 3. Anatomic relationships of the salpingopharyngeus suggest that this muscle probably acts to raise the velum and to move the lateral wall of the pharynx in a mesial direction. 4. Considerable mesial movements of the lateral pharyngeal walls were found to exist. 5. Mesial movement occurs over a considerable vertical extent. Movement may be greater at its lower than at its highest level. 6. The amount of mesial movement is directly related to the extent of velar elevation. 7. The greatest extent of mesial movement appears to occur in the area overlying the salpingopharyngeus muscle. 8. Although there are significant differences between certain vowel sounds with regard to velar and mesial pharyngeal movements, these differences are not significant for the anterior movement of the posterior pharyngeal wall. 9. The velopharyngeal mechanism does not function as a simple sphincter.

PALMER, Wichita, Kan.

Nose

ORBITAL CELLULITIS TREATED SUCCESSFULLY WITH PENICILLIN. H. O. SLOANE, J. A. M. A. **126**:164 (Sept. 16) 1944.

The author supplies the following summary:

"In a case of orbital cellulitis of the left eye in a boy of 12 the cause was established to be sinusitis involving the left ethmoids and the maxillary antrum. Operation was contemplated both for the sinus condition and locally to establish drainage and relieve the inflammation and swelling of the orbital tissues. However, under the continued use of penicillin intravenously for a period of ten days the condition cleared up completely, so that it was unnecessary to operate. Sulfadiazine in fairly large doses was tried without affecting the disease in any way and was discontinued when penicillin was administered. Local treatment was limited to applications of hot magnesium sulfate solution continuously and instillation of atropine sulfate 1 per cent three times daily."

W. ZENTMAYER. [ARCH. OPHTH.]

Miscellaneous

INFLUENZAL MENINGITIS. STANLEY S. LAMM and BERNARD H. SHULMAN, J. Pediat. **24**:408 (April) 1944.

This is a review of the cases of 15 patients with influenzal meningitis treated in the pediatric wards of the Kings County Hospital (Long Island College of Medicine Division) and the Long Island College Hospital during the six years from 1938 to 1943.

Nine of the 15 patients recovered. Treatment of 8 of the patients consisted of the combined use of sulfapyridine, type-specific anti-influenzal rabbit serum and transfusions. Seven of the 8 recovered. Two cases are reported in detail, 1 in which the patient's condition was complicated by agranulocytosis resulting from the chemotherapy (sulfadiazine and sulfapyridine) and 1 in which an apparent recovery was followed by a relapse after chemotherapy was discontinued.

A prepared plan of therapy from the moment the diagnosis is made, including the administration of drugs and rabbit serum and blood transfusions, is outlined in detail. The value of a prepared routine is evidenced by the number of recoveries obtained in the age group under 2 years.

LAMM, Brooklyn. [AM. J. DIS. CHILD.]

THE INDIANS HAVE NO WORD FOR IT: I. STUTTERING IN CHILDREN. WENDELL JOHNSON, Quart. J. Speech **30**:330, 1944.

Apparently no North American Indian stutters, according to the study made by Johnson and by his students. The languages of the North American Indians apparently do not have in them any word for stuttering. Reports of stuttering Indians have concerned those who attended mission schools and came in contact generally with white educators. The author believes this demonstrates to some extent the fact that stuttering is semantogenic.

PALMER, Wichita, Kan.

THE INDIANS HAVE NO WORD FOR IT: II. STUTTERING IN ADULTS. WENDELL JOHNSON, Quart. J. Speech **30**:456, 1944.

This article is a restatement of the semantogenic theory of stuttering. Stutterers cannot talk nonfluently. To hesitate is relatively serious in its consequences. Nonfluency is a stimulus to which the stutterer reacts with anxiety in an effort to avoid it. Stutterers should not be praised for speaking fluently. They should be praised for handling nonfluency calmly and w undue strain. They should not be exposed to ne evaluations in the environment. Stuttering is an a to avoid nonfluency. To support this hypothesis an empiric and pragmatic point of view, a numb technics are suggested.

PALMER, Wichita, K

DIAGNOSIS AND TREATMENT OF EIGHTY-FOUR CA NASALITY. ARLEIGH B. WILLIAMSON, Quar Speech **30**:471, 1944.

Corrective work was undertaken in 84 cas nasality without following the customary advice i literature. Of the 84 cases, 68 were cases of rhi aperta, 10 of rhinolalia clausa anterior, 1 of rhi clausa posterior and 5 of pseudo rhinolalia clausa following conclusions were drawn from the dat Exercises to "elevate the velum and bring it into tact with the pharyngeal wall for the non-nasal so were found to be unnecessary in all except one-s teenth of the cases. 2. Tension, inhibition in the cavity and incompleteness and distortion of reso seemed to be the major diagnostic factors in all of the cases of rhinolalia aperta and partial facto all but 1 of the others. 3. Practically the same methods—including exercises in producing resona were employed to remedy nasality. 4. General tea of the nature of resonance was effective and ach results more rapidly than practicing velar contro In the cases of rhinolalia clausa anterior the corre was much slower, but if there was breathing spa the nares, it was accomplished by practically the method. 6. The cases of pseudo rhinolalia clausa those yielding most readily to the general reso method. 7. The literature on the subject of na seems to place too much value on remedying nas fects of voice by elevating the velum and occluding nasal port; it overlooks diagnostic characteristic remedial procedures that deserve consideration.

PALMER, Wichita, K

Society Transactions

MERICAN OTOLOGICAL SOCIETY

WESLEY C. BOWERS, M.D., *President*

ISIDOR FRIESNER, M.D., *Secretary*

Abstracted by ALFRED LEWY, M.D.

Seventy-Seventh Annual Meeting, New York, June 5-6, 1944

idential Address. DR. WESLEY C. BOWERS, New ork.

e 1943 meeting was canceled because of transpor- difficulties. With improvement in war conditions s felt that a meeting should be held in 1944 to inate and disseminate new knowledge, the pursuit hich was accelerated by the war, and in particular nsider rehabilitation problems.

tstanding advances are the further development of lood bank, the use of blood substitutes, especially a in shock, and the discovery of the Rh factor. development of chemotherapy is one of the great nces of the century. Many conditions formerly dered hopeless now are controlled. Unfortunately, riminate use of sulfonamide drugs for minor ail- s may lead to sensitivity of the patient and inability se these drugs for serious infections. Penicillin, xic and effective against infections with gram- ive organisms and with pneumococci, has had its uction speeded by military necessity and will soon general use. Quinacrine hydrochloride, replacing tainable quinine, made the Pacific Ocean offensive ble.

e must not only bring our soldiers back alive but re the disabled. Plastic surgery is a natural de- ment of the work done by otologists, accustomed licate surgical operation in confined spaces. Per- nce of the labyrinthine fistula for conductive deaf- is not yet assured but is a fascinating field for er study. The prevention and the treatment of tic trauma should advance under the experience d by army surgeons, also aviation medicine, to be d later to civilian needs. With the development hemotherapy, dangerous complications of aural in- ons have diminished, and it may be necessary to ice more surgery on cadavers in order to teach the ate technic of the rarer surgical feats. It has me necessary for otologists to be thoroughly trained e field of allergy. This means a fuller knowledge neral medicine, and, reciprocally, better otologists. tary needs have curtailed specialized training. As lementary measures, colored television movies of ate surgical details may be carried to students in medical schools.

hen peace comes, those who follow the medical ssion, starting from ashes to build a new world ting from Kaiser), have a great opportunity to e the world better than ever. Quoting Baruch, this ly a period of great changes—and greater oppor- es. Let us apply our skills and initiative to protect, rve and advance. With vision, courage, resource- ss and energy we will go further than ever before.

Critical Review of Patients Subjected to Operations on the Labyrinth. Presented by DR. H. I. LILLIE, Rochester, Minn.

(Dr. Lillie's paper is not available.)

DISCUSSION

DR. MARVIN F. JONES, New York: I have observed a series of 25 patients undergoing the operation presented. Almost invariably there were areas of infection and destruction of bone surrounding the labyrinth, and I think the endaural approach may be used to advantage in getting a wider exposure of this region. There is one differentiation I use: Is the labyrinth permanently dead or has it still some function? I did not open a labyrinth that still functioned. Only 3 of my 25 patients did not get permanently dry ears. One was the subject of a psychosis and should not have been operated on; in 1 I failed to remove all the infected area; 1 with complete labyrinthectomy had a profuse flow of cerebrospinal fluid at operation and four subsequent dressings. Four slides are shown: (1) a preoperative preparation, showing extensive cavitation of the mastoid bone; (2) a postoperative one, showing the whole petrous pyramid gone; (3 and 4) slides of the sequestrum, showing the region through the internal auditory meatus, the edge of the cochlea, with the crista cochlearis destroyed, and the fistula into the horizontal canal. Evidently the labyrinthine symptoms came from the opposite ear.

When I differ from Dr. Lillie, there are many points where we coincide. I think labyrinthotomy has been abused and has sometimes caused death instead of cure. I think labyrinthectomy is the operation of choice.

DR. I. FRIESNER, New York: Dr. Lillie has had an unusual number of patients who were proved at operation to have empyema of the labyrinth. Most of the patients with suppurative labyrinthitis whom my associates and I have seen have not had pus under pressure in the labyrinth. Outside of that I think the article presents a most interesting and instructive series of cases.

DR. H. I. LILLIE, Rochester, Minn.: I reported the cases in the order in which they were observed. It must have been the physician's lack of knowledge that caused 3 of the first 4 patients to die. I am grateful to the men who so kindly discussed my paper, for there were many debatable questions.

In answer to Dr. Page, the return of function in cases of diffuse involvement has been the rule when I have performed only the radical mastoidectomy for circumscribed labyrinthitis, which was done when there were no alarming signs of intracranial extension. I can understand why he might object to the first conclusion. Opening a dead labyrinth depended on what I found. If there was no break in the integrity of the membranous labyrinth that I could be sure of (and one cannot always be sure), I preferred to defer opening it. I am also in accord with what he said about latent labyrinthitis which later contributed serious complications. I think each case must be judged individually, and not on statistical figures. To Dr. Jones I am grateful. We dispute but come out fair and square. I have never seen a specimen from the living patient like his, and was glad to see definite histologic evidence of the fistula into the canal.

In regard to Dr. Goodyear's remarks, I think that labyrinthitis developing in the course of acute otitis media is in most instances serous, but when it is suppurative, that is a horse of another color. Case 11 I thought was one of acute serous labyrinthitis, and I performed the ordinary operation on the mastoid bone for acute mastoiditis. The patient appeared well for four weeks; then diffuse labyrinthitis with meningitis developed. Thereupon the operation was performed on the labyrinth, and I am certain that pus came from the labyrinth under pressure.

In regard to draining the cochlea and not disturbing the canals, that might depend on what was found at operation. The infection does not always extend through the internal auditory meatus. It always extends to the endolymphatic sac and to the region adjacent to that where many cells are located under Trautmann's triangle. I would certainly remove the labyrinth from the posterior aspect, because the exposure is better and I am more certain to eradicate the disease. Sequestration of the capsule has been seen in which it was hanging free, held only by the facial nerve coming through it. The disease came through the solid angle and involved the dense bone of the capsule.

Perhaps Dr. Friesner makes an interesting observation, or perhaps I did not make it clear in the text. What I meant by pus coming from the fistula was soft granulation tissue bathed in pus, with more pus forming after removal of the granulation tissue. As I now recall the last case, there was an actual flow of pus under pressure when I tapped the region where the fenestra is now made.

Functional Studies on Fenestration of the Labyrinth in Animals. Presented by Dr. Karl Lowy, Rochester, N. Y.

For the last three and one-half years functional studies on the effects of fenestration operations have been made in Dr. Culler's laboratory in the department of psychology at the University of Rochester. Dr. Culler felt that the results should be presented although not yet complete or final.

Two experimental methods were at our disposal: (1) the acute, in which the electric response of the animal's cochlea is used as a criterion of function; (2) the training of an animal to respond to certain frequencies and the determination of its hearing threshold.

The first was applied mostly to a study of pigeons. The outer canal was plugged with bone wax, and the only ossicle, the columella, was thus immobilized. It is believed that this immobilizes the footplate. The electrode was connected to one semicircular canal, and the fenestration was done in another.

When the fenestration is being made, there is always a flow of perilymph. In the pigeon large blood sinuses accompany the canals. If they are injured, one gets an irreversible drop in the electric response. These sinuses are in communication with the venous structures in the lacuna in the cochlea. The theory that hyperemia causes improvement of hearing does not appear tenable, at least not as regards passive hyperemia.

A series of slides was shown: 1. The field of exposure of the semicircular canals, showing the fistula.

2. A representative collection of the results of the study of the cochlear response before and after operation. The question arises: What would the result be on normal hearing? Apparently there is improvement in hearing for air-borne sounds in normal ears.

3. A slide showing that there is usually more change for lower frequencies.

4. A slide raising the question whether inadver conduction deafness was created.

5. Fistula after three and one-half weeks; there sign of bone regeneration.

6. What happens if the fistula is damaged? Thi was coagulated with a glowing needle. That alon not seem to interfere with the effect of the fenestra

7. However, if there is removal of the membra canal there is considerable loss of hearing.

8. A comparison with bone conduction. There app to be some loss for high intensities. The results not conclusive.

9. What caused the change in hearing—the fen tion or the loss of perilymph? We withdrew through the round window; this causes loss of hea Therefore, loss of perilymph is not the cause of impr ment. If it were, the improvement would occur temporarily, as it regenerates quickly.

Nine monkeys were trained to respond to s Monkeys were used as they are the only animals anatomy suitable for the Lempert fenestration and They have no otosclerosis; so one ear was destr and the incus removed from the other. The flap held by paraffin, which required another operation fo removal. Even to clean the ear one must anesth the monkey. To determine whether the results o moving the incus approximated those of fixing stapes, we used cats, removing everything down t footplate and fixing that with paraffin. A slide sh the changes for high, low and medium frequen which averaged about the same as those with rem of the incus. Another shows remarkable retentio hearing despite widespread inflammatory changes. slide shows serous labyrinthitis without any chang the middle ear; apparently the infection took p directly through the fistula. (A third slide was sho This specimen showed very good hearing, and at fe tration we found a heavy cyst. After operation hearing decreased, probably because of rupture o cyst, but later it was recovered fully.

In 1 case we tried Pohlman's prosthesis, placin against the oval window, and found remarkable provement in hearing. It is suggested that placing against the membrane be tried in cases in which fe tration is not so successful.

Does the electric response really test the hear We can now distinguish between the nerve and cochlear response, and we believe that the coc response in the live animal is a good measure.

We realize the shortcomings of our procedures will welcome suggestions for betterment.

Speech-Hearing Testing. Presented by Dr. Dou Macfarlan, Philadelphia.

After tracing the history of testing for hearin speech, the author gives a complete summary of methods and word lists used by all the investigator this field. His article brings the topic down to

The author takes careful pains to establish his tention that it is impossible to determine with an a ometer how well speech is heard. Herein lies necessity of using words and speech as testing sti Decibel hearing loss to speech and percentage hea loss are found to be identical.

The author describes the use of the phonogr audiometer in conjunction with a decibel meter a flat or even intensity record. This allows for the ing of hearing at any level of loudness with as test words as needed.

aving used this method in his office for years in nction with frequency audiometers, he finds it nvaluable addition in following patients' hearing ency.

is felt that speech-hearing testing not only is here tay but will ultimately come into common use g otologists.

l Monaural Deafnes for Speech But Not for peech Frequencies; Misleading Threshold udiograms. Presented by DR. EDMUND PRINCE OWLER, New York.

have observed 2 patients with monaural total, or st total, acquired inability to recognize words or uage, although the speech frequencies, the cadence the variations in intensity of articulate speech were ed. There was not sufficient audiometric loss in speech frequencies to account for it. Sounds heard e useless as an aid to hearing speech. A hearing aid of no use. In the opposite ear hearing was ex- nt. It is evident that threshold audiograms alone ot necessarily reveal the true capacity for under- ding speech and are not infallible criteria for diag- s or for the prescription of hearing aids. A careful y of serial sections of the auditory tracts, nuclei centers in subjects who have shown the phenomena h I have described and who have been properly mined clinically and audiometrically will, I believe, in solving this mystery. The following hypotheses suggested as probable explanations:

Psychologic exclusion of the deafened ear to speech.

Insufficient transmission or reception of the speech ern.

A lesion of the crossover pathways (to a contra- al dominant cortex) or a lesion of the uncrossed ways (to a homolateral dominant cortex).

Anoxemia depending on circulatory stasis from nomic nervous mechanism episodes, in the homo- al or the contralateral tracts which temporarily or manently eliminates one or both of these tracts suffi- tly to interfere with the reception of proper neural erns by the dominant area of the cortex.[1] (Too y pieces of the speech pattern are missing.)

A total or crippling lack of crossing of the audi- pathways.

A total or unusual crossing of the auditory path- s.

nalysis and correlation of the observations I have e set forth lead me to the conclusion that the syn- me described, i. e., monaural deafness for speech hout sufficient loss of hearing for the speech fre- ncies to account for it and without a loss of ability remember or to produce speech properly, and usually t a persistent tinnitus difficult to mask (and maybe ransitory vertigo) may in part at least be due to ons central to the end organ—in its primary nuclei somewhere in the central auditory neurons to the e or the opposite side of the brain (or both), depend- on whether the symptoms are in the ear homolateral contralateral to the dominant area of the cortex.

1. It has been shown that there is a splitting or turing of axons in the neuroma at a point of severe uma of a nerve, whether toxic or mechanical, and t such lesions cause a dispersion or scattering of rvation to several localities by neurofibrils from a gle axon.

DISCUSSION

DR. LORENTE DE NÓ, New York: This slide is a diagram elaborated by Dr. Fowler and myself to show that it is possible for speech not to be understood while the cochlea is capable of transmitting impulses excited by sound.

Pathways from the cochlea and through the primary acoustic nuclei go to both sides of the brain. There are several crossings in the medulla, and fibers from the two ears join each other at the level of the geniculate body and go together to the cortex. If there were a lesion in the geniculate body or the cortex, it would be difficult to understand how one ear hears well while the other one is not capable of analyzing speech. Therefore by exclusion one has to place the lesion in the cochlea or in the primary nuclei of the affected side. The fact that the hearing frequencies are comparatively well heard indicates that the cochlea is not too badly affected; therefore we assume that something has happened to the primary acoustic nuclei. These have become affected so that the brain cannot analyze the constellation of impulses, which is incomplete. Stimulation remains within selected paths, and it is that orderly progresssion of impulses that makes the interpretation of stimulation possible. The acoustic nuclei are extremely complicated. One does not need any special theory to explain why neurons might degenerate in the primary acoustic nuclei. Muscles degenerate and atrophy, and if the eye is lost there is destruction of the neurons in the geniculate body.

I think it would be worth while to make histologic analyses of the acoustic centers of patients who have been properly studied clinically. There is no single complete description of the primary acoustic nuclei in man. It will be necessary first to create standard procedures. Little has been done.

DR. L. VOSBURGH LONS, New York: I am calling this the Fowler phenomenon because so far as I know it has not been described before, although I asked many neurologists and neurophysiologists. Word deafness is familiar to us all, but it is bilateral; speech cannot be understood because memories of patterns received in the past are gone, although hearing for the necessary frequencies is present. Dr. de Nó attributes the phenomenon to a degeneration in the primary nucleus which distorts the sound passing through so that when it reaches the cortex it cannot be correlated into speech. I will say that that is an anatomic possibility. There is a neurophysiologic axiom that no lesion of the central nervous system produces monaural deafness. Perhaps some persons have a dominant side which may control all hearing. This is something new that may be cleared up if an otologist sees one of these rare persons at autopsy. Perhaps all the fibers cross, then a lesion here (indicating on slide) would produce the Fowler phenomenon. I do not say this is so but that it is logical. It may also be that in some persons there is no crossing at all, which would also explain the situation. A lesion in the secondary center for memories of speech could also give it.

A Comparative Study of Whisper Test Records and Audiograms. Presented by LIEUTENANT COLONEL JOSEPH L. GOLDMAN, Medical Corps, Army of the United States.

I have had the opportunity to study a large number of audiograms of Army Air Forces personnel and to compare these with the records of whisper tests and

of low conversational voice tests. A comparison revealed that there was no constant correlation between the audiometric average decibel loss and the recorded perception of the whisper or the low conversational voice.

Audiometric and whisper examinations were made routinely on a total of 167 men. The average decibel loss for 256, 512, 1024 and 2048 double vibrations per second, a range which was supposed to include the speech range, was computed. The acuity of hearing for whisper was determined by the method prescribed by the War Department. The cases were classified according to type of deafness as follows: (1) nerve type deafness, (2) conduction type deafness, (3) mixed type deafness, (4) deafness associated with otitis media, (5) deafness following injury or specific disease, (6) deafness following mastoidectomy and (7) otosclerosis.

Series of cases are reported showing graphically the inconsistency between the loss measured in decibels and the loss measured in perception of whisper. As a result of the study of these data, I believe that the human voice still offers the best means for determining the acuity of hearing for speech. I do not pretend that it presents the most accurate means of interpreting a man's hearing perception. Audiometric findings offer great aid in the diagnosis of different types of hearing impairment, a permanent record of hearing, and a record of variations over a period of years. With flying personnel, it is of value in detecting evidences of nerve deafness in the early stages.

It is suggested that men performing the fenestration operation may give valuable information in the records of improved hearing by accompanying their audiograms with records of whisper and conversational voice tests.

DISCUSSION

MAJOR ROBERT J. HUNTER, Philadelphia: I find there is a great difference in examining military personnel and civilian personnel. One reason is that candidates often do not know what the answer should be and form an opinion according to the distance of the examiner. If I get an inconsistent answer, I check with the audiometer with masking. I want to use the Bárány buzzer, the Stenger test and the Lombard test. If these correspond, I consider the answer correct. I want to do the audiometric tests myself on an audiometer which I have personally standardized on people with supposed normal hearing. Mine shows a little dip at 512, and if I get such a reading I know the answer is honest. I also like to take a test on myself to estimate the noise level as measured against my own hearing, which I know. In my private practice I use the whispered voice. In the Navy the low spoken voice is used, and I have been impressed by how consistent the results have been.

I think the paper represents a splendid piece of work, but I should like to ask whether the doctor did all these tests on a personal basis.

CAPTAIN RAYMOND TRUEX JR., M. C., A. U. S.: There are 650 patients in the hospital. There is no correlation with what they said in the past regarding their hearing. Each patient now has an audiometric study in a soundproof room, and we find no correlation with the whispered or the spoken test as described in the Army manual. These tests are done by well trained men. We find 6 or 7 feet (about 2 meters) of difference between two testers in the twenty minutes between tests.

DR. EDMUND P. FOWLER, New York: The subject is simply, clearly and factually presented. First I should like to ask what else is the matter with men besides their hearing. In regard to the cas which equal deafness was shown in the two ea which the record of the whisper test corresp with the audiogram, it may be suggested tha bilaterally deaf are adapted to faint sounds. know how to listen. The whisper is a test for only. It is not a test for the modulated voice, the audiometer. They are different methods of ing, and they test for different things.

Many factors enter. Environmental noise affect patient's hearing and also the examiner's voice. is unavoidable. The acoustics of the room, the re tion from the back wall, the failure to close the ear perfectly—all affect the test. The masking be too little or too much. I think it should be sufficient to cut out the testing sound in the other

In bilateral difference in hearing the poor e psychologically shut out. If the ears are equal, are used. Attention is focused on the good ear. makes a difference if the patient is accustomed to tester's voice or whisper; his education, his I. Q. attention are factors, so that whatever other testi used the audiometer should be the basis for estimate.

If complete audiograms were made, not only threshold but for above-threshold intensities, then proper thought and work one could correlate the au gram with the capacity of the patient to hear ab anything one wants to compare it with, and so de mine the capacity of his ears if he has the will attention to use it.

DR. LEROY M. POLVOGT, Baltimore: Colonel G man interprets all the audiograms with loss for tones as demonstrating nerve deafness. I should to ask about the nasopharynx of each patient. W the patients all fliers? Their common complaint i obstruction of the eustachian tube, a condition in w the first tones lost are the high ones. I should like to know whether all these tests by whisper w made by the same person.

DR. JACOB L. MAYBAUM, New York: Were t tests repeated or done only once for each person tried the whisper test on 2 patients who had un gone the fenestration operation eight months and fi teen months previously, both of whom heard a whi at 4 feet (about 1 meter) before operation. The heard the whisper at 18 feet (5.5 meters) and the sec at 20 feet (6 meters). The latter had a 60 decibel before operation. Another test, done by Dr. Lem showed that a patient who heard a whisper at 3 (about 1 meter) now hears it at 18 feet (5.5 mete We have no audiogram of this one. This paper tainly convinces me that there is no adequate hea test for accurate evaluation of hearing. Dr. Fo said the audiometer determines the capacity for h ing. It does not tell how one can interpret spe I believe light can be thrown on that from the provement following fenestration by performing tests now at the otologist's command, particularly audiometric test in relation to the whisper. Vari as the whispered voice is it gives an indication of improvement.

LIEUTENANT COLONEL JOSEPH L. GOLDMAN, M. A. U. S.: Every patient had a complete examina of the upper respiratory tract. There was no t obstruction or any pathologic condition of the na pharynx. Otosclerosis was diagnosed on the hist the findings regarding the hearing and examinatio the middle ear. All the men were tested by my

well trained technical sergeant under my direct vision, as carefully as they would be in private ice. Of course, there is the individual factor of f. Tests were repeated when necessary. We had a instances of psychogenic factors. The audiometer frequently checked on normal ears. Much has written on this subject, largely in the nature of etic explanations. In the army one is confronted the need to make important decisions on hearing quickly and often. I feel that I express the on of my colleagues that the present tests are equate to gage a man's hearing perception. That e practical significance of this paper. We need finite program to improve hearing tests. We must mine whether a man can hear the signal code, beams and other communications, and we have ests available for these specialized sounds. This ing presented as a factual report; I feel that I n amateur in this field as compared with the men nt, but I have been impressed with the lack of available for the purposes of my work and would to hand that information on.

lateral Deafness. Presented by DR. WALTER UGHSON, Abington, Pa.

rofound loss of hearing in one ear is a difficult lem from a diagnostic and from a prophylactic point. The patient's margin of safety is greatly ced. The hearing of the single good ear is more y masked by extraneous noise. There is confusion roup conversations. The location of the source of sound is difficult. Speech and sounds on the deaf may be entirely missed. A loud tinnitus, if present e deaf ear, may mask the hearing of the good ear me extent.

he following analysis is based on studies of 1,400 s of unilateral loss ranging from slight to complete:

Local infection: The therapy is specific.

Toxic involvement resulting from acute streptoic infection of the nasopharynx. The branch to acoustic division is almost always affected, not ssarily that to the static division, of the labyrinth. overy seldom takes place. The involvement of the rinth will probably persist for some time.

Trauma. Fracture through the ear with escape of brospinal fluid results in destruction of both the ic and the acoustic division of the labyrinth. Blast ries are usually bilateral. This acute type of hear- loss is most devastating from a psychologic standt. Acoustic trauma may affect one ear only.

Ménière's disease: The effectiveness of conservatherapy can be gaged as well by the audiometric y as by the relief of symptoms. Few reports of effect of therapy have been controlled by this type examination. Ménière's disease occurs in adult life, this particular aspect has never been thoroughly lored.

Tumor: Tumor of the acoustic nerve and cerepontile tumor can be diagnosed in their early es only by means of the most careful and repeated iometric studies. By the time the classic picture elops they are seldom curable. Every case of unlained unilateral nerve deafness should have new th ruled out. In my series four tumors of the in have been observed, three of which were diaged. Four of the patients were operated on. One rvived. This patient had a giant cell tumor of the maxillary fossa.

At present with a school population of 535 deaf children, 5 give a history of bilateral hearing loss developing after mumps. All contracted parotitis before the age of 3. Encephalitis is frequent in patients with mumps. Deafness following mumps is often complete, always irreversible. The static division of the labyrinth is seldom involved. We have no specific data as to the pathologic aspects of the condition. Mumps have been subclinical, and this relationship has been investigated by Dr. Enders, of the department of bacteriology of Harvard Medical School. Of 16 patients available for cutaneous and complement fixation tests, 6 have a positive history of mumps. All special examinations failed to contribute to the diagnosis. Encephalitis with or without clinical mumps may be responsible. Some of the patients with no history of mumps gave a reaction typical for those who have had this disease. Perhaps in some of the sporadic cases of supposedly congenital deafness this condition was due to subclinical mumps. Any virus disease may have a similar toxic effect. Local treatment in cases such as these is mentioned only to be condemned. A report of a relationship between maternal German measles occurring in early pregnancy and embryonic defects in the infant, especially deafness, is extremely significant.

DISCUSSION

DR. W. E. GROVE, Milwaukee: This paper has been stimulating in several directions. The question of how much disability is caused by total unilateral or monaural deafness is puzzling. That monaural deafness does cause some disability is perfectly true, but it certainly does not cause as much disability as does monocular vision, to use another paired organ of sense as an example. Hughson places this disability at 10 per cent. The table of compensable disability adopted by the American Medical Association fixes it at approximately 12 per cent. A questionnaire sent out some years ago to otologists all over the country by Austin Hayden brought answers that indicated the disability ranged all the way from 5 to 50 per cent. However, because of the fact that one can, to some extent, compensate for a totally deaf ear and because of the fact that, although sound travels in a linear direction as far as one individual ear is concerned, there is some reflection of sound from the surrounding surface, an estimate of between 10 and 15 per cent is probably quite fair.

In making an audiometric test Dr. Hughson masks the better ear when the over-all difference between the two ears is 30 decibels or more. If I remember correctly, Bunch advocated masking the better ear when the difference between the two ears exceeded 40 decibels. May I ask Dr. Hughson to explain in more detail why he has chosen the figure 30?

I must take exception to Dr. Hughson's statement that "direct physical force resulting in injury to the temporal bone with bleeding from the middle ear and escape of cerebrospinal fluid will result almost inevitably in complete destruction of the static and acoustic divisions of the labyrinth of the affected ear." My own experience with a large number of such injuries is just the opposite. In the great majority of cases of fracture of the temporal bone the fracture is a longitudinal one which runs along the anterior border of the pyramid, crosses through the middle ear and ruptures the membrana tympani. The meninges may be torn by such a fracture, resulting in escape of cerebrosinal fluid, but the otic capsule is not directly involved in the fracture.

In a survey of 211 cases of demonstrated fracture of the skull which I published in 1929, I tabulated the hearing loss in 108 cases of unilateral longitudinal fracture and in 34 cases of bilateral longitudinal fracture. In this series 8 ears had normal hearing, 76 ears a slight loss, 69 ears a moderate loss, 85 ears a marked loss and only 9 ears a subtotal loss. In no instance was there total deafness. The loss of hearing in these cases was of a perceptive type and was undoubtedly due to hemorrhage into the basal coil of the cochlea, caused by the concussion of the labyrinth and not by the fracture per se. Of course, when one deals with a transverse fracture which crosses the pyramid and opens the otic capsule, the picture as to total destruction of the static and acoustic divisions of the labyrinth is exactly as Dr. Hughson has painted it. Fortunately, transverse fractures of this type are rare.

In Ménière's disease the unilateral deafness varies greatly from time to time. Here one is dealing with hydrops of the labyrinth, which may vary in intensity from time to time. When the pressure is acute, the hearing loss will be maximum. When it subsides, the hearing will improve. The end picture is that of a high degree of unilateral deafness.

The auditory nerve is probably the most vulnerable of all cranial nerves to such general and systemic diseases as typhoid, scarlet fever, measles, diphtheria, influenza, syphilis, leukemia, pernicious anemia and diabetes. Politzer commented on the fact that a large number of cases of mumps had been reported in which the function of the auditory nerve was quickly arrested and in which complete deafness followed.

That unilateral deafness occurs in all of these systemic conditions cannot be denied, and its occurrence following one of these more or less general systemic conditions has always intrigued me. That the hearing loss following mumps is "most frequently unilateral" is a matter to which my attention has not been particularly drawn. It may be so. It is well known that the virus of mumps attacks most of the tissues of the body and frequently causes meningitis of a mild or a severe degree. If the deafness were due to this meningoencephalitis, one would expect it to be bilateral in a majority of the cases. Therefore, Hughson's assumption that the virus itself directly attacks the neural mechanism of one or the other acoustic nerve is probably well taken.

In this connection, Dr. Max Fox, the epidemiologist of the Contagious Hospital of the Milwaukee Health Department, who has written the article on epidemic parotitis in the new edition of Tice's "System of Medicine," which will soon appear, tells me that he has never observed deafness, either unilateral or bilateral, caused by mumps. This observation by one who to my knowledge is a careful clinician makes me wonder whether the deafness which has been ascribed to mumps was in reality due to that condition.

At any rate, this has been an interesting and stimulating paper.

Dr. H. I. Lillie, Rochester, Minn.: My observations have been divergent from Dr. Grove's. While I was serving in the control of contagious diseases at the University of Michigan there occurred an epidemic of mumps, and overnight many of the victims were unilaterally deaf. In examining any unilaterally deaf patient I always inquire whether he has had mumps. I am convinced that mumps may be the cause of complete unilateral deafness.

Dr. E. P. Fowler, New York: I think the ba test is valuable in demonstrating total unilateral ness. No matter how high the observer raises loudness, there will be no change in the relatio between the loudness required to balance, because ear will be hearing all the sound. The other ear give a "shadowgram."

Tinnitus is usually not as loud as the patient it is. Give him a similar sound and balance wit tinnitus. Tinnitus is caused by irritation of the n element. It gives the sensation or illusion of s I do not think there can be tinnitus in any freq range without some deafness in that range. I wi point out the relationship of tinnitus to the ma effect on the good ear. This is not the mecha effect of the tinnitus as such; it is due to the functioning of the nerve elements whose injur causing the deafness and the tinnitus.

Dr. H. Marshall Taylor, Jacksonville, Fla. should like to ask Dr. Hughson if he has ever unilateral mumps followed by deafness on the side. I wondered if a patient could have anox or swelling of the nerve head similar to that Bell's palsy and cutting off of the blood supply, w is a rare sequel of serum sickness. I have se cases of unilateral deafness from mumps and the ness was on the side opposite the mumps.

Dr. Burt R. Shurly, Detroit: In the last the American hospital at Vitré, France, opened 400 patients with mumps. In none of them did ness develop, but many had orchitis or epididym In the Spanish War I was connected with two pitals where there were 3,000 patients with ty fever, something which will never be seen agai the history of medicine, thank God! Aural symp were practically absent; there were occasional la geal developments, but the point is that in thous of infectious diseases this phenomenon (unilateral ness) is quite infrequent.

Dr. Walter Hughson, Abington, Pa.: Dr. Gr experience is much greater than mine, but his ob vations are associated with skull fractures, indus accidents, while I referred to direct trauma of the Perhaps my cases were cases of transverse frac In Ménière's disease normal variation shades the e of therapy. Few cases have been reported in w careful audiometric studies have been made. My p is that one can anticipate beginning remissions exacerbations better by careful audiometry than noting subjective symptoms and that thus an exa bation may be aborted if taken early. I have n seen a case in which I could attribute unilateral d ness to syphilis, and rarely bilateral deafness. Grove's experience and that of his colleagues reg ing mumps and deafness would indicate that the tionship is unusual. I agree. My associates an are reporting 6 cases of direct association of unila deafness and mumps. However, we have 10 u plained cases, and I am presenting this possible ex nation. I am grateful for Dr. Lillie's having obser a group. Perhaps the epidemic of unilateral deaf had to do with the virulency of the particular vi So far I know of no similar incidence as the re of epidemics reported by the Army Commission Contagious Diseases. I think the pathologic char will be demonstrated only as atrophy of the ne mechanism of the ear, and that has been demonstra in many other cases of unexplained cause.

Dr. Fowler questions my statement that in comp unilateral deafness the loudness balance test is not

portance. Complete unilateral deafness is of course ceptive in character. In this study we are con- ed only with the deafened ear, the other being mal. Were a bilateral loudness test done in a case complete unilateral deafness, incorrect results would obtained. The shadow curve which is obtained in audiogram unless masking is used, would also be ent in the loudness balance test. Owing to this s over effect, a constant type loudness balance e is obtained which is just as inaccurate as the low curve on the audiogram. Consequently, in plete unilateral deafness with the opposite ear mal a loudness balance test is of no diagnostic e.

showed an audiogram of a patient who had com- e unilateral loss and a constant loud roaring tin- s. The otic capsule had been destroyed by a or. The tinnitus was somewhere else. It masked hearing of the normal ear in quiet surroundings. regard to unilateral deafness with unilateral mps, 1 patient had the mumps on the side contra- ral to that of the totally destroyed hearing. Dr. rly reported 400 cases in which mumps was not ciated with deafness but was accompanied with e orchitis. One wonders if the hearing loss may e gone unobserved on account of this uncomfortable plication.

gress of Aviation Otology in World War II. Presented by LIEUTENANT COLONEL PAUL A. CAMPBELL, Medical Corps, Army of the United States.

was the lot of a few of us to be in service in initial stage of the preparation of plans for the ction of young men to be classified as pilots, navi- rs, bombardiers, air-crewmen or ground service . Today I will report some of the later develop- nts.

Many members of this organization had their share the era of the early growth of the program. The sion of those of us who were otologists was: first, train a sufficient number of physicians to handle logic situations; second, to prepare standards for selection of Air Force personnel to meet the ex- ding program; third, to study means of protecting personnel from otologic damage.

During the earlier phase of aviation medicine a few usand people had been flying; now hundreds of usands might be required. Aircraft had grown ger, and their crews had increased in size. Planes become faster, more powerful; operational alti- es had more than doubled, and the operation of g personnel might be worldwide.

Most of the physicians being trained for flight sur- ns were originally in general practice. One of the mbers of the first class, graduating just before rl Harbor, was the first medical officer to lose his in World War II. He was Lieutenant William Schick. These embryonic flight surgeons had to trained in all the aspects of air medicine and taught build slit trenches and bomb shelters, prevent ma- ia, take care of camp sanitation and numerous other ails. There has been no shortage of applicants; so standards have not needed downward revision.

Much research effort has been spent in the prob- s of aviation otology through the coordinated ac- ty of civilian and military agencies. One problem the effect of aircraft noise on the ear. Men vary tly in their susceptibility. One man has a perma- t defect after 200 hours of flying; on the other hand, I have an audiogram of a pilot with 20,000 hours of flight showing no effect. Much effort is being devoted toward the development of a test which will discriminate between the vulnerable and the invulnerable.

One effect of noise is its interference with the intelligibility of radio communications. Confusion of such simple words as "northeast" and "northwest" might lead to serious consequences. Furthermore, the pilot's roadway in the air is a 1,000 cycle beam along which he must fly. Some normal persons hear better in noisy surroundings than do others. It is important to determine who these people are. Tests are in the process of development. Pure tone audiometry is insufficient in the selection of men best able to meet communications requirements. Mass audiometric tests combining pure tones of the beams, the Morse code signals and selected spoken words in a background of noise are being developed.

Aircraft noise cannot in practice be inhibited by soundproofing, which would decrease gasoline and bomb load or affect maneuverability and gun manipulation. Direct protection of the ears by helmets and ear defenders is not yet satisfactorily solved.

Research in aero-otitis media has continued. One of the outstanding achievements has been the use of pressure chambers for the indoctrination and classification of flying personnel. This teaches them the need for oxygen and brings out the blocked eustachian tubes, and also teaches them not to undergo pressure changes in the presence of a head cold. The outstanding contribution to the treatment of external otitis due to fungi has been made by Captain Ben Senturia and Corporal Fred T. Wolf. All of the Allies have devoted much time to the study of air sickness. The correlation between the Bárány chair tests and air sickness is found to be less reliable than a swing with a radius of 14 feet (4 meters). It was found that there are many variables due to psychogenic influences, dietary indiscretions, poor ventilation of cabins, fatigue in the air and other conditions. Those sensitive to motion alone adapt themselves to the motion of aircraft. Few of those in whom the emotional factor is predominant progress well. Several actual flights under varying conditions constitute as yet the only highly reliable selection procedure. Of the drugs, scopolamine and similar drugs are the most efficient protectors but must be prescribed with extreme care. Much excellent work will probably go unreported until the war is over. Time has not permitted the mention of the names of many important investigators.

DISCUSSION

LIEUTENANT COMMANDER ROBERT J. HUNTER, M. C., A. U. S.: We are fortunate because Colonel Campbell's position as director of research at the Army Aviation School puts him in a position of intimate contact with the problems of aviation otology, with power to apply a guiding hand.

One question raised is: Why is there a dip in hearing in the frequency range of 4,000 cycles per second in men exposed to noise? I would ask: Is there significance to the fact that the hearing for frequencies in the speech range has not been affected? Can it be that the damping effect of the stapedius muscle or some other physiologic reaction protects the speech range and the damage is done elsewhere? Also, otologists do not yet know how permanent is the effect of acoustic trauma. Kobrak has shown that there is one pathway for loud and another for minimal sounds, and Bekesy, mentioned by the Colonel, says that for

loud sounds the stapes rotates on its long axis and for minimal sounds it rotates on its posterior pole. This may be a protective reaction. The idea appeals to me that there may be a reaction similar to that in the eye, in which there is one physiologic method for the perception of ordinary light and another for the perception of minimal light, as apparently shown in dark adaptation experiments.

My experience corresponds with the Colonel's that many of the men are unaware of the defect. By contrast one man noticed that he had to ask people to repeat. He had a marked defect. His associates in the shop who had a dip at 4,000 cycles answered normally to the standard Navy test with whispered and spoken voice.

Otologists have gone a long way from the days of Willis to the day of Fowler and are ready to go forward and get new data. My experience is limited, but I have not been able to demonstrate that the hearing of these men improve with rest. Most of the men I have seen with acute otitis from gunfire either had a cold or were poorly selected. The aviators I see are well trained and selected; so the aero-otitis among them is probably due to a cold or to excessive smoking, made worse by sudden barometric changes in the presence of a closed eustachian tube. Few cases are on record with a complete history, examination and histologic specimen. An effort should be made to get these.

The military requirements and the short time allotted Colonel Campbell and myself made it necessary to speak in generalities.

DR. RALPH A. FENTON, Portland, Ore.: I should like to ask the Colonel to comment on the availability of his trained flight surgeons for civilian aeronautics when this field has priorities again, also on the difference in acoustic trauma between combat personnel and the other air services, and whether or not the use of amphetamine sulfate is frowned on.

DR. H. I. LILLIE, Rochester, Minn.: Studies were made before the war on some of these problems in the Boothby clinic. As an otologic consultant with Dr. Boothby, I had many discussions with him. Some persons have thick, some thin, drum membranes. I have the feeling that the membrana tympani, the ossicles and the muscles are protective rather than conductive. I wonder if the type of middle ear mechanism of the fliers who have little trouble has been investigated. I think that farmers with flaccid membranes have more hearing trouble when riding noisy tractors. Is it a fact or a prejudice that keeps persons with bilateral large perforations out of the service because it has been proved that they are more subject to aero-otitis?

I have a son who is in the air corps, and although he divulges no information that he should not, I suspect that he has some of these questions on his mind.

LIEUTENANT COLONEL PAUL A. CAMPBELL, M. C., A. U. S.: Since Pearl Harbor, between 3 and 4 per cent of all the doctors in the country have been through the Army School of Aviation Medicine, and they will be available. Regarding amphetamine sulfate, the army frowns on vasoconstrictors, for one reason that men should not fly who have a cold. When a man must go on a mission, it is allowable for him to use a vasoconstrictor. I do not know whether this one is superior to others. I do not know the answer to Dr. Lillie's question regarding the type of middle ear mechanism.

Traumatic Deafness: Problems of Preventi

Presented by DR. H. MARSHALL TAYLOR, Jacksonville, Fla.

The organ of hearing was the last of the sense org to develop. It has the least power of recuperat from injury of any of the human organs. Until industrial age, probably the loudest noise to which human ear was subjected was thunder or a volc explosion. The human ear is not equipped to w stand the noises of warfare and some of the indust Man is vulnerable to acoustic trauma. The basal t of the cochlea, where perception of high notes is loca is close to the oval window and exposed to vio thrusts of the stapes in response to impulsive sou

Since Fosbroke presented his paper on traum deafness, in 1831, a great deal of literature has ac mulated. Bunch in 1937 cited 160 articles. Since time there has been a virtual renaissance in this s ject. Since the introduction of audiometry, otolog have had a more accurate measure of sound. It been established that sound becomes painful at fr 115 to 130 decibels. The sound of riveting and sounds produced by the chipping hammer, the airpl motor, the airplane propeller and a stream of air un high compression are all above this level. In the f World War, it is estimated, there were 40,000 ac casualties; for the present war the estimate is 250,0 The War Department has issued a statement that he ing aids will be furnished to personnel in active m tary service suffering from hearing defects when s aids will improve their hearing. Prescribing and fitt of hearing aids will be limited to the Deshon Gene Hospital, Butler, Pa., the Borden General Hospi Chickasha, Okla., the Hoff General Hospital, Sa Barbara, Calif., and other hospitals for the rehabilitat of the deaf which may be subsequently designa With injury, the hair cells of the organ of Corti generate, and the damage spreads and is not confi to the particular part originally damaged.

In 1866 Chippendale recommended the wearing cotton in the ears by persons encountering gun Cotton is the least efficient of all ear defenders, giv an insulation of 7 to 12 decibels, but is the most co monly used. The only protective measure recommen by the Bureau of Medicine to flight surgeons is wear ear defenders if these are available; otherw carefully applied, close-fitting cotton plugs should worn. These plugs can be obtained from the M Safety Appliances Company, Pittsburgh. However, seems to be an unwritten law among aviators that t use cotton, and this at their own discretion and pref ence.

Has the otologist assumed his responsibility in t important branch of preventive medicine, and has been as alert as the immunologist in the prevention infection? Hundreds of thousands of dollars have b expended in the study of the amplification of sou and the laboratory research directed toward the provement of hearing aids. The results of those effo reach a most remunerative field. The value of a m ern hearing aid is $100, while that of an ear defen varies from a few cents to a dollar or two, which a pecuniary aspect of this subject not to be disregard

One deterring factor is that invention of a perf acoustic insulator for every type of environment occupation is perhaps impossible. An acoustic insula of a soldier in the jungle that prevented the hear of the rustle of leaves or the snapping of twigs wo not be practical, nor could an ear defender shut a noise such as was heard more than 2,500 miles

when the great eruption of 1883 blew away the canic island of Krakatao. Between such extremes re is a place for acoustic insulation, and cooperative earch will eventually perfect this needed means of tection. A propitious moment for such an investi- ion is at hand. The price of one torpedo or of a sion paid one deafened casualty would provide the essary funds to defray the expense of a complete dy that would at least advance the science of acoustic ulation.

The present emergency has stimulated an interest in subject. A Navy communication dated Oct. 1, 3 states that the insulation value of cotton varies m 3 to 18 decibels for all frequencies, whereas the tection afforded by ear defenders ranges from 30 40 decibels. Ear defenders are being procured and to be distributed to crews of antiaircraft and double pose guns and to the engineer forces of Diesel- pelled ships. While these are being placed in pro- tion, the ear defenders of the Mine Safety Appliances mpany may be procured.

The Carnegie Corporation in October 1925 granted ubsidy of $90,000 for the study of otosclerosis. If American Otological Society could develop such husiasm for the prevention of traumatic deafness as manifested at a dinner given by the late Dr. A. B. el on the occasion of starting an endowment for the dy of otosclerosis, this subject would not be in the eveloped stage it is now. As a result of close tact with the personnel of a number of military ps, I have seen a large group suffering from trau- ic deafness. I believe that if the members of this iety could come in immediate contact with riveters operators of chipping hammers or would spend e time on the firing line of the gunnery schools, y would reach the same conclusion that I have, t cotton as an ear defender is obsolete. It cannot compared with the defenders developed by Dr. udsen and the Surgical Mechanical Research Com- y (S. M. R.) or with the plastic model advocated Lieutenants Cox and Geller.

At the Naval Air Gunnery School at Jacksonville, , it became necessary to rotate officers serving as tructors on the firing range who used cotton, which ved ineffective. The Cox and Geller plastic model nced complaints and supplanted cotton, with good ults. It has frequently been said that workers in sy factories will not use ear defenders; this is not e. Persons who have been furnished defenders have sed to work without them. Those who refuse to ar them are already suffering from a high degree nerve deafness and do not experience pain or incon- ience from the loud noises. My experience has n that those wearing the plastic plugs or the Knud- defenders were relieved of discomfort and could verse with ease. The aviator flying in the top gun ret of the flying fortress is especially susceptible acoustic trauma. This turret is an enclosed chamber. The Army does not recommend any particular type ear plug. The Navy recommends the defenders of synthetic rubber developed by the Mine Safety pliances Company, Pittsburgh, which will soon be mass production. This information seems not to e been widely disseminated. The Jacksonville Naval Base is using cotton plugs and the plastic defender eloped by Cox and Geller. The Knudsen defender fully described in an article entitled "Ear Defenders" Norman A. Watson and Vern O. Knudsen, pub- ed in the *Journal of the Acoustical Society of erica* (**15**:153-159 [Jan.] 1944).

A perfect ear defender must be easy to insert and must be retained well; it must be light in weight and unbreakable; it must decrease noise of high frequency without impairing seriously the hearing of commands. Cleanliness must be especially considered. Shea recommends the use of castor oil as protection against otomycosis.

Cooperation between the otologist, the militarist and the physicist in making a constructive approach to this pressing problem is of paramount importance.

DISCUSSION

DR. CHARLES T. PORTER, Boston: I happen to have belonged to the first organized skeet club in America, and we all got deaf. I made audiograms for all the members, whose ages varied from 18 to 60 or so. The younger members showed loss beginning at 1024 or 2048 cycles but decreasing at higher frequencies; the older members had about the same level for low frequencies but the hearing did not come back in the higher frequencies. They used a 12 gage shotgun; so you can imagine what a 50 caliber machine gun will do when fired on all sides. Skeet shooters get deaf in the ear which is habitually held upward. In the Air Forces there is in addition the air stream and the engine noise. The helmets furnished are not sufficient protection. The Royal Canadian Air Force helmet has sponge rubber, which is soft, with a zipper to close it. I hope that Colonel Campbell will be allowed to loan some of his men to the other services to teach those services something about protection of hearing.

A man in a machine gun outfit had me give him a letter and an audiogram. The major agreed as to the diagnosis but could do nothing about it. It was a 50 caliber gun outfit, and the boys were not even using cotton. I wish to commend Dr. Taylor for one of the most valuable and timely papers.

DR. W. E. GROVE, Milwaukee: This is not only a wartime but also a peacetime program. In workers in heavy industries in general these hearing losses occur, but efforts to investigate the problem more closely have been frustrated by both industry and labor. I wonder if an obturator in the canal would prevent intensive sound from reaching the drum. In the cold climate where I live people use caps and ear muffs. I wonder if a well fitted ear muff of heavy sponge rubber, with an elastic band applied outside the ears might not work as well as an obturator in the canal.

DR. D. E. STAUNTON WISHART, Toronto, Canada: If any member of this society will take any of these miserable protectors sent me by one of our departments, and put it in his own ear he will know why the men don't want to wear them. Some of the protectors go far into the canal and are painful. I think Dr. Taylor should have emphasized the most dramatic thing and that is the two helmets he is passing around. Compare them and say which you would want your boy to wear for protection of his hearing. This practical paper directs attention to two important things: first, protection of the men; second, protection of the country afterward in bringing attention to disability claims. On one hand we have terrific cost to the man in service and on the other the cost to the country.

DR. K. M. DAY, Pittsburgh: It is already too late to prevent acoustic damage to thousands of men, but I hope this paper may have paved the way for the future. We are also faced with casualties from industrial noises, but up to the present little has been accomplished in the field of prevention or defense. I have had personal ex-

perience with only the Knudsen defender and the S. M. R. The fault of the Knudsen device is the metal core, which may cause fatal injury if driven into the head by explosion of shell fragments. One of the national research institutions has become acutely interested and wants more accurate information as to the character of research work required.

I hope I am not out of order in suggesting that the American Otological Society at its next business meeting should appoint a committee to formulate plans and recommendations for handling this problem.

DR. MOSES H. LURIE, Boston: Dr. Taylor is to be congratulated on being able to say things which my colleagues and I wanted to some years ago. I have been connected with research work on this subject but am under oath and Dr. Taylor is not. How he obtained this information surprises me. It will be of interest that the helmets used in the armed services are being rapidly changed, and the new ones in some ways surpass those of the Royal Air Force. The British and American research councils have worked intimately together. The purpose of the small steel bar in the Knudsen defender is to filter out the high tones which do the damage, which the synthetic rubber does not. The trouble is that they must be individually fitted; they are now made in three sizes, and every man should have his own in his pocket. Artillery and tank men do not like to put them on. I do not know why except that they complain that they cannot hear commands and have to pull them out to know what is going to happen. What effect this will have on the desired protection is a question.

The object of the men in the fighting forces is to win the war as soon as possible, and up to the present they have had to pay the price. Research has to be by trial and error, and when methods are perfected and given to the forces it is up to the Army and Navy to apply them. Their point of view is that a certain percentage are going to come back deaf and that is a part of the price the nation has to pay to win. I do not think we should criticize them so severely for not putting these things into effect.

We are catching up slowly but are now achieving rapid progress. The civilian population will benefit but not many of the boys at present.

DR. H. MARSHALL TAYLOR, Jacksonville, Fla.: I wish to emphasize that a riveter in a boiler shop does not know that he will become deaf. I have not intended to criticize the Army or the Navy. We are charged with doing our duty as otologists in the interim. I think the Colonel will tell us that I have not and that he and I are going to be gracious friends.

DR. MOSES H. LURIE, Boston: I did not mean it that way.

DR. H. MARSHALL TAYLOR, Jacksonville, Fla.: Factory noise is a hazard, and we otologists shall be remiss if we do not make some defender against it. The newcomer in these industries may wear one, but the man who has lost 30 decibels will not. We should do something about this large army who will be deaf if we do not prevent it.

Acoustic Trauma of the Organ of Corti in the Guinea Pig. Presented by DR. M. H. LURIE, Boston.

Two hundred guinea pigs' ears were exposed to sounds of high intensity and the organ of Corti studied for pathologic changes. The least detectable anatomic damage was the disappearance of the mesothelial cells in a limited area from the scala tympani surface of the basilar membrane. This was produced by a freq of 1,000 cycles per second at 140 decibels applied three minutes. More intense tones and longer expos produced degenerative changes, rupture and disloc of the organ of Corti. A few weeks later the orga Corti disappeared and the nerve fibers and gang cells showed degeneration. From this stage there no regeneration. Mild degrees of damage were lo ized. Severe exposure caused widespread dam When caused by low tones, the damage was nearer helicotrema; when caused by high tones it was ne the round window. When mesothelial cells alone w damaged, regeneration sometimes took place. Dam to the organ of Corti by loud tones might occur with injury to the ear drum or the ossicles. There was s general correspondence between changes in the "e trical audiogram" and the anatomic changes. The st of anatomic changes is more consistent and reliable estimating injury than is that of the electrical acti of the cochlea.

DISCUSSION

DR. HARRIS P. MOSHER, Marblehead, Mass.: I seldom that a more meaty paper has been presen before this society. The three authors were there, the government sponsorship makes it impressive authoritative. It is clear and refreshingly short, the illustrations are superb.

These experiments go back to Ziegelman but h been carried out with modern apparatus and mo methods of measurement, and therefore are more p cise. Sometimes the conclusions are guarded. T hundred animals were subjected to sound experim and their inner ears sectioned and studied histologic —a herculean job. I feel that these experiments on effect of sound on the organ of Corti are the m convincing and informative to date. It is striking h quickly this organ degenerates when exposed to n physiologic sound; also noteworthy is its lack of generation. The stripping of the mesothelial cells the inner surface of the basilar membrane is interes and, as I understand it, is the earliest effect of acou trauma. Their loss is an indication of the location the trauma. This is a pretty happening. There considerable spread to the traumatized portion. adherents of the Helmholtz theory would like it to as a child playing the piano with one finger, not a pebble thrown in the water and spreading waves. T would be a help to me. The membrana tectoria c through unscathed, and the mystery of its function still unsolved. Reissner's membrane I should th would be a target. Nothing seems to have happened it or to the saccule and the utricle.

Bunch held that the cochlea was more sensitive sound around 4,000 cycles per second. All otologists familiar with that dip in their audiograms. I ho for some explanation, but the attempt to prove this not work out right if I understood the paper correc I never rose to full confidence in the Weaver-B theory. These gentlemen could not make it fit and to resort to anatomic observations. If they could make it fit, one cannot put it down to stupidity, as is a professor of physiology, another an assistant p fessor of otology, and the third, I believe, a Ph and all are Harvard men.

DR. H. B. PERLMAN, Chicago: Theoretically, findings reported add evidence of a difference of fu tion of the outer and the inner hair cells. The ou appear to be more sensitive and probably respond smaller stimuli. Experience suggests other points difference also. There is no doubt that the organ

shattered by an acoustic stimulus. This cannot be lied in man because of rapid postmortem degeneration he end organ. Dr. Lurie observed irreversible and progressive damage. Clinically, one sees evidence both irreversible and reversible damage in the shold curve. The sound intensities used in these eriments are rarely encountered in civilian occupas. Hence one rarely sees in man profound loss or gressive loss after exposure is stopped.

The greater the intensity the shorter the time needed oduce damage; lesser intensities may cause damage olonged; below certain intensities no length of exre will do permanent harm.

y co-workers and I exposed young human adults to e tones of about 100 decibels of intensity for one r. Low frequencies were less traumatizing than h; 64 cycles per second was found to have produced threshold change when the ear was tested three utes after exposure; 2048 cycles at the same insity for the same time produced loss requiring three s to recover. The audiogram always showed a rp dip—oddly enough the maximum—at one octave her than the fatiguing tone. Patients with acoustic uma show a high tone loss or a high tone dip reidless of the kind of noise. The noise level meter, the ear, must be used around the pain threshold, a difference of 10 or 20 decibels may mean the ference between rapid and very slow deterioration. e meters are not reliable for measuring the intensities very brief sounds, common in industry: metal stamp, riveting, and so on. A shock pulse with a duration one thousandth of a second and a value of 200 ibels is an example. (Slides are shown.)

Slide 1 is a record of the pressure to time relationship. e whole episode, during which the sound may reach eral hundred decibels of intensity, is over in about -thousandth second.

Slide 2 shows how the human mechanism translates t into some physiologic reaction. This can shatter end organ of the guinea pig. The importance of h sounds is that they enter the ear before the mechsm can protect the ear.

Slide 3 is a record of the latent period of the human pedius muscle in response to a one-thousandth second nd; the electric phenomenon that occurred in the scle as picked up in the tendon shows that for ten nts in the thousand there is no reaction. Consently, through this period the cochlea is unprotected l liable to great damage. I should like to ask Dr. ie some questions. Was any recovery noted in the al microphonics? Did he note any change in the a vascularis? Has he noted any similar disruption the mesothelial cells with other types of pathologic olvement of the cochlea?

Dr. E. P. Fowler, New York: I should like to ask Lurie about the absence of the narrow dip. Do you d that in the pickup from the nerve and not in that m the cochlear electronics? Theoretically, the chlear response would have more spread and the ve a more localized effect. The specimens Dr. Lurie wed are different from the fatigued human ear, n which one can get recovery; from destruction one not.

Dr. Burt H. Shurly, Detroit: Have any experints been done with protectors in the ears?

Dr. Gordon Berry, Worcester, Mass.: I should like ask Dr. Lurie to clarify my mind as to which cycle nge did the most damage. From the pictures I thought was above 2000.

Dr. M. H. Lurie, Boston: The most important problem was to demonstrate unquestionably actual damage to the organ of Corti. In the beginning it meant going through every one of 200 to 300 sections per ear to see what actually happened. When the stripping of the mesothelial cells was noted, my co-workers and I thought we might get a clue. Ten years ago we had that evidence staring us in the face and did not see it. The stripping is an acute thing and does not occur with intensities that do not cause actual acute damage. (Slides are shown.)

Slide 1: This, published ten years ago, shows the stripping which we missed; here is the basilar artery, unruptured, and the mesothelial cells stripped clean.

Slide 2: This animal received quinine; the organ of Corti has disappeared, but the mesothelial cells are about normal. Slide 3: The same.

Slide 4: This animal was exposed to 2000 cycles at 120 decibels for a month. It did not knock off the mesothelial cells but caused vibration of the basilar membrane and degeneration of the external hair cells. The mesothelial cells are all present. It is a demonstration of the fact that the basilar membrane vibrates with intense sounds. There is a snap the whip effect in both directions, one on the mesothelial cells in the scala tympani and one on the organ of Corti.

Slide 5: A congenitally deaf dog; there is practically no organ of Corti, and the mesothelial cells are all present.

Slide 6: The waltzing guinea pig, an animal that inherits deafness. The mesothelial cells are present, and the outer hair cells are degenerated.

Slide 7: A waltzing guinea pig with degeneration exactly as in traumatic conditions—no nerve, no organ of Corti, but the mesothelial cells intact. The end result in the organ of Corti is the same no matter what the type of damage.

The Weaver and Bray phenomenon is still controversial. Dr. Davis and I have been wrong several times, but we keep trying and hope in this way to help settle the problem. Regarding the spreading effect: The cochlea works as a whole and cannot be expected to keep tones in specified places.

In answer to Dr. Perlman: Our primary objective was to find out what sound or how strong a sound would destroy the organ of Corti. We had no time to test out the aural microphonics to see if recovery took place. In answer to Dr. Fowler: We did not determine the effects off the nerve. We had no time for that kind of investigation.

Dr. Perlman mentioned dangerous sounds. They are the high tones. In the human subject recovery takes place if there is no actual damage. The same happens in animals. In some of the animals tested with microphonics there were slight losses, 5 or 10 decibels. Histologically, we found nothing indicating a temporary change. We did not observe the stria vascularis.

Dr. Shurly: The protectors have been gone through thoroughly.

Dr. Berry: The most dangerous cycle range depends on the intensity. In the tone used, 500 cycles per second, the intensity was so great that one felt as if one's clothes were being torn off and every organ in the body vibrating. In general, the most dangerous tones are above 2000. Low tones were filtered out of airplane noise, and the high tones caused loss. Exposure to supersonic tones caused high tone loss. One can stand airplane noise because of the low tones. If these are filtered out, one cannot stand the high tones.

SYMPOSIUM: THE REHABILITATION OF THE WAR-DEAFENED

I. Historical and Veterans' Aspects.

Presented by DR. GORDON BERRY, Worcester, Mass.

It is estimated that there will be close to a quarter of a million aural casualties in World War II (estimate of Dr. Walter Hughson in his "Manual for the Rehabilitation of Aural Casualties"). Major Walter E. Barton, of the Surgeon General's office, gives a much lower estimate. During 1918 and 1919, 108 deafened soldiers received systematic training in United States General Hospital No. 11, Cape May, N. J. Inability to hear normal conversation beyond 5 feet (1.5 meter) was the criterion for rehabilitation. The average time for completing the lip-reading course was two and seven-tenths months. Seventy-four per cent of the students were graded as understanding over 80 per cent of what their teachers said to them in efficiency tests. Then Miss Enfield Joiner went to Washington, D. C., for another year for the purpose of finding and taking care of those who did not find their way to Cape May. Five hundred more handicapped men were discovered and civilian teachers of lip reading provided for them. The men going out of the Cape May school all did well financially. This was a chapter in reconstruction in which the individual members of the American Otological Society played a prominent part, and it has served as a pattern for the more extensive and finer work being done in this war.

In 1942 the American Otological Society and the American Laryngological Association appointed Dr. Harris P. Mosher, Dr. George M. Coates and me to further any rehabilitation program the military authorities might contemplate. At first the Army and the Navy planned to restore such men as they could to active duty and discharge all others through the Veterans Administration. On our suggestion, it became the policy of the Surgeon General of the Army to retain for fitting with hearing aids and for instructions in lip reading all soldiers who had impaired hearing.

There are two types of aural casualties; in some men the handicap is "service connected"; in others it is not. Those with service-connected disabilities may look to the Veterans Administration for help. Those whose defects are not service connected may look to the Federal Security Agency and the State Vocational Rehabilitation Services. The veteran with the service-connected condition, before he is discharged, makes application for a pension. If a vocational handicap is determined, he will be advised to make application for vocational training. In our special field, the Veterans Administration plans for a central staff of experts in Washington to give over-all supervision of vocational rehabilitation of veterans. If the Veterans Administration finds the disability service connected, he is entitled to the training needed to restore his employability. Any educational institution or well established enterprise may be utilized. The course of instruction can be up to four years in length and will be available six years after the termination of the present war. With respect to aural casualties, the Veterans Administration supplies the repairs and the batteries for the hearing aid given the veteran before his discharge and provides for disability compensation or its equivalent in earned wages. No further hospitalization or formalized lip reading is contemplated under military auspices.

A man whose deafness is not service connected may be looked after by the Federal Security Agency in conjunction with established vocational rehabilita services. The Vocational Rehabilitation Amendm approved by the President July 6, 1943 provide fo peacetime as well as a wartime program, includ services necessary to render disabled persons cap of engaging in remunerative employment. These clude surgical and medical care, hospitalization, tr ment, appliances, vocational guidance and train maintenance during training, and placement in emp ment. For war-disabled civilians, including the Citiz Defense Corps, the Aircraft Warning Services, Civil Patrol and the Merchant Marine, the fed government will assume the entire cost and half cost in others, the state paying the remainder, some exceptions in which the civilian is able to for medical care. The Federal Security Agency pl to distribute to the states copies of the "Manual Rehabilitation of Aural Casualties" sponsored by American Academy of Ophthalmology and Otolar gology.

In May 1944 the House of Representatives pas the bill, which the Senate is also expected to p giving the following benefits: twenty-six weeks unemployment compensation at $20 a week; loans to $2,500; tuition up to $500 a year for four ye in school or college; employment service and placement.

May we not conclude that our nation is earne seeking to follow the behest of our great Abrah Lincoln in his immortal second inaugural addre "Let us strive to finish the work we are in; to b up the nation's wounds; to care for him who s have borne the battle; and for his widow, and orphan—to do all which may achieve a just and las peace among ourselves with all nations."

II. The Rehabilitation Program of the Na Aural Casualties.

Presented by COMMAN FRANCIS L. LEDERER (MC.), U. S. N.

There is no authoritative source of statistics fr the last war to guide one in an estimate of the au casualties in this war. We of the Navy group f comparatively few patients whose hearing disabi existed prior to enlistment. As a rule, the man ex ined by us prefers to remain in the service. Ev effort is made to rehabilitate him to perform th tasks for which he is best qualified. If this is possible, it is our purpose to give him a basic cou in lip reading, and whenever indicated to furnish h with a properly fitted hearing aid if he may be b efited by it. There will be no indiscriminate distri tion of apparatus. Furthermore, the serviceman m be given opportunities of social contacts while wear the aid so as to bring about his adjustment to its u

In offering a brief outline of the rehabilitation eff of the Navy I am mindful of the fact that the Am can Otological Society, as well as others, has eff tively influenced the plans by its past efforts and willingness of individual members who have given unselfishly of their time. It must be a fundamen principle that we maintain liaison with groups such the one this organization represents. The Surgeon Ge eral, Admiral Ross T. McIntire, has stated that reh bilitation shall be interpreted as meaning all activiti and services which may be required to supplement usual therapeutic procedures in order to achieve ma imum adjustment of the individual patient either further military service or for return to civil life w the least possible handicap.

The program in each naval hospital is in charge of ehabilitation officer. Other members of the medical f are designated to act as a rehabilitation board. Office of Rehabilitation has provided selected hos-ls on the east and west coasts and central depots the management of aural casualties in need of ial rehabilitation efforts. These hospitals have been ecially designated in close proximity to medical ools, universities and institutions for the hard of ring and where there are facilities for the training lip-reading instructors, speech correctionists and er specialists. Examining personnel must be highly ined and in sufficient numbers. It is specifically ected that all audiometric examinations and tests be ducted in a soundproof room and that an audiometer epted by the Council on Physical Therapy of the erican Medical Association be used for measure-ts of both bone and air conduction. Any service-h with a line of duty hearing disability of 30 decibels the better ear is qualified for special rehabilitation rts. The Office of Rehabilitation has organized rate units in two naval hospitals adequate in size facilities to handle the maximum number of aural alties. In addition to other special equipment, each includes examining rooms and individual rooms instruction in lip reading and correction of speech. rsons trained in the fitting of hearing aids are part the unit's staff, and no commercial factor is per-ted to figure in this effort. Facilities are available making individual ear molds. Lip reading is ght all personnel whose deafness is not amenable to ficial aids and those whose hearing defects are arded as progressive.

Arrangements are being made for the rehabilitee to tinue his study and work in the city nearest his e or place of employment. When speech training ssential and proper personnel is not available, the ch clinics in state universities, colleges and other itutions are used for this purpose. A psychologic raisal is made of the individual rehabilitee's intel-nce coefficient, interest and aptitudes, educational l and social and vocational abilities. Vocational lysis requires the sympathetic assistance of a psy-logist and psychiatrist with experience in the man-ment of the deafened. When the handicap ssitates entry into an entirely new field, it becomes ssary to evaluate the man's total training and erience. Efforts during hospitalization are directed ard achieving preparation for the proposed course action after discharge. Careful vocational guidance important during hospitalization to bring about a ductive use of leisure and to restore self confidence. Prior to discharge, the patient is referred to the terans Bureau Administration for the purpose of anging any benefits to which he may be entitled for advice as to opportunities for reemployment to the Red Cross for assistance in arranging his ate affairs, the purpose being a resumption of an nomically independent status in civilian life. Con-erable attention has been given to an efficient ow-up service of Navy and Marine Corps person-Many plans remain nebulous; only now have suf-ent data accumulated to serve as a basis for practical grams. The number of blast casualties is mounting. ere are many new problems in the rehabilitation of al casualties. Military medicine will welcome the peration of the American Otological Society and er scientific bodies in their solution.

III. Hearing Rehabilitation at Deshon General Hospital. Presented by CAPTAIN E. H. TRUEX JR., Medical Corps, Army of the United States.

The service of otolaryngologists for the rehabilitation of the hard of hearing originated at Walter Reed General Hospital a year ago in the Ear, Nose and Throat Section. The number of patients was far greater than originally anticipated. The project was transferred to Deshon General Hospital, Butler, Pa., Borden General Hospital, Chickasha, Okla., and Hoff General Hospital, Santa Barbara, Calif. Since Nov. 1, 1943, more thn 600 patients have been admitted to Deshon General Hospital alone because of defective hearing, and we are now carrying more than 300 names on the roster.

A large number of men for whom no aural abnormality was shown in the induction record gave a history in our clinic that indicated long-standing deficiency. I believe that twenty-five years from now the Veterans Administration will be paying compensation to more than 100,000 patients because of defective hearing attributed to this war. I believe that 10,000 patients will be admitted to these centers during the next two or three years. War Department Circular 81, section IV, paragraph 2, states: "Every case in which the impairment of hearing shows a true loss in the better ear of 30 decibels of hearing within the conversational range (256-2,048 decibels) or a loss to 3/15 or below to whispered voice, . . . free from acute inflammatory disease, will be transferred . . . to a hospital designated for the rehabilitation of the deaf at the earliest practicable date."

Many combat aviators and men exposed to explosives, and the like, will have partial deafness. Many of these will be classified as "potentials," and undoubtedly will swell the number of hearing rehabilitees over a period of ten or twenty years. In a series of 392 consecutive patients admitted to Deshon General Hospital, 69 per cent had hearing impairment on induction, and 20 per cent attributed the disability to blast or noise.

Our purpose is to restore to the former condition or status. Our objectives are as follows:

1. Accurate diagnosis.
2. Institution of therapeutic measures for improvement or cure.
3. Intensive instruction in lip reading.
4. Supply of the best available hearing aid.
5. Teaching the deafened patient to use the hearing aid to maximum advantage.
6. Prevention and correction of deteriorations in speech.
7. Assistance of the victim in avoiding mental and emotional aberrations.
8. Assistance of those unfit for further military service in assuming their place in society.

A group of 32 of our personnel consists of 4 otologists, 1 psychologist, 1 acoustic physicist, 4 acoustic technicians, 2 speech correctionists, 1 instructor in hearing aids and 19 teachers of lip reading.

Our hospital is a permanent structure and is expected to be taken over after the war by the Veterans Administration. We have a large workshop, three soundproof chambers, the finest available equipment for diagnosis and for the evaluation of hearing instruments, 30 small rooms for individual instruction in lip reading and a large room for group hearing aid. Ninety per cent of our patients have damage of the neural mechanism. Cure is out of the question; so hearing aids plus visual

reception of speech are the mainstays of hearing rehabilitation. We are authorized to purchase any hearing aid accepted by the Council on Physical Therapy of the American Medical Association. Two totally deaf men on whose wrist we strapped, or who held in the finger tips, a bone conduction receiver were helped, at least psychologically.

The pure tone gain is first measured for each instrument; second, the tolerance limit for pure tones is determined. The instrument that handles the higher intensities without discomfort is preferable. From these figures the dynamic range is computed. The patient is then tested to determine his loss for connected speech without and with the aid. With these tests the patients find marked differences between different aids, and the one that gives the best performance throughout the series is selected. Satisfaction with hearing aids in 80 per cent is the utmost that can be expected. One cannot hear normally with such an aid, and cerebral reorientation as to quality and intensity of sound must be made. Proper instruction materially enhances a man's benefit from his hearing aid. We aim to train the patient in discrimination of sound, of direction and of tonal quality, and how to use his aid to maximum advantage. Forty-five minute daily lessons in lip reading are given every day. Exercises, recreation, occupational therapy and various pedagogic programs are integrated under the direction of the Red Cross. Minor speech defects are found in 50 per cent of the patients admitted. These patients are given corrective instruction during the eight weeks of hospitalization.

The Veterans Administration has an arbitrary plan for continuing the rehabilitative measures and instituting vocational training. A staff in each of the three hard of hearing centers has the privilege of research. With the large volume of patient material, it is expected that new tests of auditory acuity will be devised and old tests improved, and it is anticipated that refinements in the performance of hearing aids will result. Auricular training of residual hearing is a relatively new field. Satisfactory tests of lip-reading proficiency with moving pictures will be forthcoming. The possibility of superior psychometric tests is being explored. It is the aim of this service to establish a pattern encompassing all phases of treatment for the disability with which we are concerned and to offer that pattern to the physician and the layman.

IV. The Civilian Program of the American Academy of Ophthalmology and Otolaryngology.

Presented by DR. DEAN M. LIERLE, Iowa City.

The Committee on the Conservation of Hearing of the American Academy of Ophthalmology and Otolaryngology has learned that service men and women will receive adequate care during their service and before discharge. Certain ones will seek private aid, and others will continue to need help after their discharge from the armed forces. The committee, therefore, will try to reach only those seeking civilian aid and offer its services to the medical branches and the Veterans Bureau during and after the war.

Civilian otologists should read government reports on: (1) the incidence of the various types of aural casualties; (2) the efficiency of the different types of treatment; (3) the technics of fitting hearing aids; (4) speech-making problems; (5) psychologic and vocational readjustments. Some of the patients will be able to adjust, but a large number will need help in making personal, social, vocational and economic adaptations.

This presents a challenging series of possibilities reconstruction in lip reading, fitting of hearing a psychologic and psychiatric study, vocational trai and efficient follow-up service. At present there too few centers with adequate professional staffs equipment. There are many places where parts of program can be carried out. The committee be with the following program: (1) preparation o manual; (2) appointment of state representatives, will establish when necessary one or more clinics complete facilities.

The manual is completed, the representatives h been appointed, and directives have been sent th The organization of local clinics will depend lar on local conditions. The manual contains in de the suggested program.

DISCUSSION OF PAPERS PRESENTED BY DR. GORDO BERRY, COMMANDER FRANCIS L. LEDERER, CAPTAIN E. H. TRUEX JR. AND DR. DEAN M. LIERLE

DR. WALTER HUGHSON, Abington, Pa.: I was tunate in having had an informal association with armed services in the inception of the rehabilita program, which redounded only to my benefit. Th presentations are most thrilling. For the first ti the implications of the disability of deafness are ap ciated and steps are being taken to handle the t problem under a broad concept. The total service is going to be rehabilitated. The recognition of psychologic implications is the background. The tails are completely and carefully thought out in final implementation of these plans. One thing t stands out is the enthusiasm, the earnestness and eagerness to help exhibited by the personnel in th two units.

A large number in Captain Truex's series had he ing loss before induction. The effects of the tra of war on this hearing are disquieting. We can longer advise deafened patients to take up noisy wo This organized effort is what all have hoped wished for. It will continue throughout the war the postwar period and cannot help but develop techn and facts that may well revolutionize the present c cept of, and approach to, the problem of deafness.

DR. CHARLES T. PORTER, Boston: It has not b brought out that the Army accepted draftees wit minimum loss of 10/15 in one ear. This with the f that their hearing would be more vulnerable than t of normal inductees was known when they went i service. They constituted 69 per cent of the Capta patients. They did not get in under false pretens Should they not have preferential treatment?

DR. E. P. FOWLER, New York: When these soldi are rehabilitated and returned to civil life the R Cross and the societies for the hard of hearing sho come into play. This year is the silver anniversa of the American Society for the Hard of Hearing, every chapter is back of the rehabilitation movem and giving their personal services. Many of th paid employees are in government service, and I ho that all otologists will join these societies and h in the work.

DR. ALFRED LEWY, Chicago: Reference has b made to people employed in noisy industries sustain damage to their hearing. Most of the states now h workmen's compensation laws. The state of Illino the only one I am familiar with, recognizes only t unilateral or bilateral deafness. I believe the Ame can Otological Society could do something by advoc

compensation for hearing loss that is not total but industrially disabling.

DR. GORDON BERRY, Worcester, Mass.: I too am d of the work which makes such a contrast with small but earnest beginning in the last war. I h to second Dr. Fowler's remarks about the Ameri- Society for the Hard of Hearing. They have been constant liaison work with the Army and the Navy, Miss Betty Wright, their executive secretary, has n granted leave and is now in Deshon General Hos- l working with Captain Truex. I am sure it will a great gain for all. Mr. Greenman is the new aging director of the American Society for the rd of Hearing. Mr. President, may I have the ilege of asking him to stand?

One question I should like to ask Captain Truex: e those who enter the Army with some hearing airment more susceptible to acoustic trauma than rmal persons?

CAPTAIN E. H. TRUEX JR., M. C., A. U. S.: The per cent was based mostly on subjective history, only 53 per cent of 106 patients who said they had ring loss showed this on the induction examination. have interviewed patients who said that they had d lip reading for five years before entering the Army. e patient told the induction examiner that he had d lip reading, and he was pushed through with a k of 15/15. Some of the patients said the test con- ed of clicking a coin or "hollering" across the room, some had no test. We have no figures at present on effect of trauma on already damaged ears, but it is impression that the condition of these ears has been le worse. Our only figures show that 19 of the 392 ents with previous hearing difficulty had aggravation ervice, caused by acoustic trauma.

COMMANDER FRANCIS L. LEDERER (MC), U.S.N.: I k not for the record, but as an individual. I am e that when we say "off the record" none of the mbers of this society will tell more than he tells best friends.

The Army has been most helpful to us in the Navy, I hope we will achieve what the Army is doing, we do not aim for duplication of effort. There no use in our duplicating Dr. Lurie's work. The nea pigs will not react differently at the University Illinois, and we have full confidence in Dr. Lurie. ertheless, there is a spirit in the Navy which im- es this on us. Our boys in the Navy and the rine Corps expect us to take care of them, and I sure the gentlemen here will appreciate that there is ollege spirit in the armed forces, but a friendly . My experience with the Army's cooperation hes into China, where they have been doing a derful job, and they gave me that help at Deshon eral Hospital, for which my commanding officer nowledges his gratefulness.

was asked how many teachers of lip reading we . We have not the staff of 31 that Deshon Gen- Hospital has. I doubt we will have that number, nse we are interpreting the disabling disease as g service connected. We work in a veterans' fa- y where we get not only men of the Navy and Marine Corps but men of the Army and Army erans, and we take care of the families as well. We anxious to establish this unit, and the Navy is g a green light for the installations we ask for, ding a specially prepared acoustic laboratory, which mbers of the American Otological Society are out- g for us.

The limited duty men taken into the Navy have not always given the service we sought. They are too often sick bay casualties. Limited service in the Navy may mean diving into the water, and one knows what that may mean to an ear. We should like to head off the men with susceptible ears.

If I have not given you figures, it is because I do not have them. Dr. Schenck asked questions which he thought the members would want answered, but the Surgeon General said that in the interests of security some of them should not be. Many of them I could not answer through ignorance; I do not know how many casualties there are, and I do not know the answers to many questions which Dr. Schenck apparently asks in his own mind. I have presented this paper in Dr. Schenck's name.

Rehabilitation of the Child Who Is Handicapped by Deafness. Presented by DR. RUTH P. GILDER and DR. LEROY A. SCHALL, Boston.

Forty-three children were given hearing aids for conduction deafness when the loss in the better ear approached 30 decibels. Air conduction vacuum tube aids were more successful in all of these except 6 who required bone conduction aids, 1 because of bilateral malformation of the external and middle ear, 4 because of intermittent otitis media, and 2 because decision was based on the poorer ear when the loss in the better ear was still relatively slight. Hearing aids have been placed on 19 children for partial high tone deafness. In these children the development of speech is somewhat retarded and imperfect. It is important that this defect be discovered early in order that correction may be made for it. Hearing aids have been placed on 38 children for more marked nerve deafness. These children possess varying amounts of residual hearing but less than the two preceding groups. We have recommended an aid only when the child had some hearing vocabulary, or proved under training that he was able to acquire one, and when we believed that the child, the parents and the teacher would work to make the experiment worth while.

The youngest child to whom we now give a hearing aid is 3 years of age, so that the child has the opportunity of forming auditory images from the beginning. Let him acquire a knowledge of lip reading, but let the auditory function take over to the greatest possible degree. Hearing aids have been placed on 14 children during their preschool years. Three of these are now in regular classes with the help of instruction in lip reading; 2 entered schools for the deaf. Of the 9 still of preschool status we expect that 5 or 6 may enter regular classes in public school when the time comes.

(The author's paper concludes with the following summary.)

1. With the possibility of better hearing through the vacuum tube hearing aid, children with irreversible handicaps of hearing call for expanded clinic programs as never before.

2. In recognition of this new need, a program of rehabilitation has been developed at the Massachusetts Eye and Ear Infirmary as an integral part of a clinical research program on deafness at the younger age levels.

3. The individual child is studied from the standpoint of general health, mental development and school achievement, special disabilities of hearing, speech and language, and social adjustment to his handicap.

4. On the basis of such studies an individualized program is outlined, including a recommendation of a

hearing aid, clinic training in the use of the aid, development of better listening habits, instruction in lip reading combined with better hearing, and speech correction whenever the facilities for it are available.

5. Hearing aids have now been placed on 100 children, ranging in age from 3 to 18 years and including 43 children with conduction deafness, 19 with partial high tone deafness and 38 more with marked nerve deafness.

6. Criteria for the recommendation of hearing aids and other remedial measures and the results obtained are given separately for each group.

7. The importance of the earliest possible habilitation of the preschool child and his educational placement on the basis of his maximum potential hearing is emphasized by the results obtained in 3 young children.

DISCUSSION

DR. D. HAROLD WALKER, Boston: I have watched the progress of Dr. Schall and Dr. Guilder. They started from nothing and have developed a regular laboratory for the training of the deaf child and the young deaf adult. Dr. Schall did not mention the tact required in training say a 3 year old child and the intricate problem of testing the hearing. Dr. Guilder is a mistress of various arts, particularly of testing hearing by audiometers, tuning forks, visual objects and other means. It requires patience and a knowledge of the psychology of both children and older people. The tests are necessary to apply a program. The early use of a hearing aid is needed especially to improve intonation. Study of the child's home environment and cooperation of the parents are also necessary. Adolescents object to a hearing aid. It is hoped that hearing aids can be made less conspicuous. One young lady said to me, "Can you imagine me going to a dance with a brick on my thigh?" In older children with otosclerosis the fenestration operation is justified. I believe that laboratory research will eventually discover the cause of otosclerosis; then the problem will be one of prevention as well as cure.

DR. C. S. NASH: We should like to see conservation of hearing centers of the same type established in many cities. Pediatric, otologic, sociopsychologic and educational matters are part of the rehabilitation program. If they had limited the group to ages 3 to 16, it would also raise a problem of secondary education. Some children have to go to regular classes, others to special classes and some to the schools for the deaf. The first group presents no problem. With the second and third groups decisions must be made as to which departments they shall be trained in. These departments continue only because they have pupils. Dr. Schall has tabulated the results, but has done much more: The children have been adjusted socially and psychologically in a way that cannot be measured, and that is a great accomplishment. I like to have before me a chart of all the children in a definite group. My co-workers and I classify as group A those with a loss of 30 to 40 per cent; B, 40 to 60 per cent; C, between 60 and 80 per cent, and D, 80 to 100 per cent. In our school there will be 1 or 2 in group A; 85 per cent will be in group D. Against this is the enrolment in special classes of the public school; 85 per cent are in group A and very few in D. The school for the deaf does not want children in the 30 to 40 per cent group; the special classes do not want those with 90 per cent loss, but want those with loss somewhere in between these extremes, and those children are the problem of a cation. We must anticipate the ultimate disposal each child as to secondary education and avoid riv between educational factions. Our county society ported a project for a nursery for preschool deaf dren. The determination of what classes they belo in caused considerable discussion. The state dep ment of education had to settle the problem of all tion. If that problem has not yet arisen in Massachusetts Eye and Ear Infirmary, Drs. Sc and Guilder have been both diplomatic and fortu They are doing a splendid piece of work.

DR. BURT R. SHURLY, Detroit: The problem larger than is suggested by the excellent work under the leadership of the Massachusetts Eye Ear Infirmary; it is impossible for various cities emulate that standard. In the schools in Detroit whe child is found with defective hearing, a card is sen the family physician, who has not yet been mentio He is a problem, because many times he is not s ciently interested. A card is sent also to the pare whose cooperation is needed. If necessary, a sec card is sent to the doctor, but if nothing is done, school nurse follows up. Dr. Nash has classified loss of hearing from the educational standpoint. we in Detroit fail with the family doctor and the p ents, we have to refer the children to the var clinics and hospitals where we hope something ca done about it. We have a fine school for the d and the vast majority of children requiring hea aids belong there. We have tried first to diagnose deafness, then to put the child into the proper cla fication, and in case the parents and the family do fail, to give the child a chance for medical supervis which is after all the key to the whole problem.

DR. E. P. FOWLER, New York: In the last t years my co-workers and I have examined 100 c dren from the public schools of New York. One have been fitted with hearing aids, the other half We have paired them off as to hearing loss and int gence quotient. I hope by next year to give yo report on the subject. One must think of more t the educational standpoint. One must do them s good from the medical standpoint. In many cases otologist can prevent an increase in their deafness.

DR. W. E. GROVE, Milwaukee: Could not Guilder have the privilege of the floor to tell us the difficulties of this work?

DR. LEROY A. SCHALL, Boston: May I introd Dr. Guilder, the real author of this paper?

DR. RUTH GUILDER, Boston: It is a privilege be at this meeting and hear the discussion on the s beginning we have made on a large problem. greatest difficulty we felt was that brought up by Walker: trying to adapt the method of the study hearing to various age levels. There is variation one goes down the age scale, especially below 12 ye Yesterday it was brought out that above 12 years age the patient hears speech better than one wo expect from the audiogram, but as one goes down age scale this condition is reversed. One needs w to study the child so as to get an idea of his hear ability, also of the character of his disability. Th is the attention factor; one must make the subj interesting. We have developed play conditioning te nics for the ages 2 to 5 and have taught the child to do certain things to get a conditioned reflex response to a bell or a drum tap or other sound, that is carried over to voice or whisper. In this

could get a response with and without a hearing although we could not explain to them what was ted. Then we tried to develop methods for higher s and to adapt them to phonograph records. We included the high school age, which did present ial problems, as brought out by Dr. Nash. So we studied the disability at all ages with the idea working out a rehabilitation program for the needs each. We have tried to have group teaching in ous fields as described by Dr. Schall, and indi- al teaching for those needing it. We felt that the school group needed to be brought together. If only boy in a high school wearing a hearing aid es to the clinic and realizes that there are many rs, it helps him, and he can have training in how se it. Many have been trained to use only their and depend on lip reading, and may need to be ed to. The high school age also presents social blems, as mentioned by Dr. Nash.

We have revised our criteria for educational place- t to include a complete study of the child on the s of maximum potential hearing—not on the hear- initially indicated in our tests, but on the best ing that can be obtained in a clinic with special nics for building it up. This is the responsibility the otologists.

s Dr. Shurly says, the parents and the family sician must be more interested in the possibilities the handicapped child. I believe there has been an easing interest among physicians outside the oto- c group, especially pediatricians, judging by the ber referred, and also among nursery school teach- because we believe it vital to discover a hearing bility as early as possible, before the child feels ressed or inferior.

periences in Surgical Treatment of the Facial Nerve. Presented by DR. PIERRE VIOLÉ, Los Angeles.

What can be done to restore symmetry of contour the physiognomy is valuable, but the goal of the aryngologist must be the restoration of emotional tion as well. In the treatment of facial paralysis stomosis with other nerves has been performed varying results. To the late Sir Charles Ballance the late Arthur B. Duel is due much credit for fundamental work.

n 1927 Bunnell performed the first successful end nd anastomosis; a procedure which produced emo- al facial expression naturally. Bunnell also orig- ed the use of a graft to join the separated ends of affected nerve. Martin in 1931 reported a success- end to end anastomosis of the facial nerve with roximately complete recovery of function. Ballance Duel, doing extensive work along this line, did not rt their results until between 1932 and 1934.

wo considerations in repair of the facial nerve are gested for discussion: (1) the indications for opera- ; (2) the time and the technic of operation. ether the paralysis is due to (1) inflammation or ma, (2) damage to the nerve without severance or actual severance of the nerve cannot be told by cal examination. The original operator is not prone dmit severance of the nerve during the operative edure and, fortunately, the incidence of this acci- is rapidly diminishing. A negative response to faradic test has been used as a guide to surgical rvention. Ballance and Duel believed exploration fer procedure in uncertain cases. Kettel has fav- exploratory decompression and has expressed the view that complete facial paralysis occurring in immediate connection with simple mastoidectomy carries a grave prognosis under conservative treatment. He admits the possibility of waiting seventy-two hours after the onset of palsy if the faradic response is lost, as proposed by Tickle. Fowler Jr. expressed the belief that the ticlike movements following facial paralysis are characteristic of peripheral nerve injury. He urged the earliest possible relief of peripheral nerve palsy. In my experience, several patients reacting negatively to the faradic test have recovered spontaneously. In many instances of acute disease of the middle ear, spontaneous recovery may be anticipated following careful treatment.

In acute infection of the mastoid bone with involvement of the facial nerve, the decision for surgical treatment is primarily governed by the indication of the mastoid infection, with a good chance of recovery following mastoidectomy. In chronic involvement of the mastoid bone involvement of the nerve is a prime indication for surgical treatment. McCaskey stated that nonsurgical treatment is best suited to paralysis due to systemic disease. It thus becomes a question of judgment of the surgeon as to which patients would be served best by operation and which may be expected to recover spontaneously.

As to when to operate, the consensus points conclusively to the advantages of early exploration and repair when there is evidence that spontaneous recovery is unlikely. Ballance and Duel stated: "The accepted time is now; no delay is justified." It is my belief that even in cases of long standing, hope of benefit from surgical intervention should not be abandoned. McCall and Gardiner expressed the belief that the criterion for operation in cases of long standing is the reaction to galvanic stimulation. The positive response is the indication for operation; a negative response means muscle degeneration—and it is useless to attempt repair under the latter circumstance. Sullivan reported a case in which a successful nerve transplantation was done fourteen years after the development of paralysis.

Three general methods of surgical treatment have been employed: 1. Decompression of the nerve; following simple decompression, recovery frequently has been rapid. 2. End to end anastomosis if the gap is brief. 3. Nerve transplantation if the breech is too extensive for direct suture. General surgical opinion today prefers nerve grafting to the "rerouting" method described by Bunnell. Several finer nerves may prove better than a single large nerve graft. The present day choice is a living nerve graft used immediately after removal, and any nerve of suitable size will do for the purpose. My personal experience, in agreement with Tickle's, is that the external femoral cutaneous nerve is the most accessible and desirable. A frozen fresh graft is being advocated by Army surgeons. The shorter the graft the quicker the regeneration. Youth has also been recognized as a factor in quiet repair. Nonsuppurative repair is desirable, but my results have been equally satisfactory whether infection was present or not. Progress is being made in the use of blood fluids instead of sutures to maintain the graft in place. One of the most recent developments is "fibrinfoam sponge." This does not have to be removed, as it is eventually absorbed. My experience that the function of the frontalis muscle rarely returns, although other branches may attain normalcy, is supported by Martin. In the suppurative field it is more important to suture the nerve.

DISCUSSION

DR. ROBERT C. MARTIN, Niagara Falls, N. Y.: I have a friendly disagreement with Dr. Voilé on minor details in that I do not believe that emotional control returns, although tonus and voluntary motion may be good in a young person operated on early after the injury. The picture shown of the patient smiling was taken after he was told to smile. It was not an emotional but a volitional response. The assumption that mass associated movements are due to misdirection of the branching axons of the proximal stump may be correct. It fails to explain contractures or overaction of the restored muscles, and it does not explain the ticlike facial movements in patients who are undergoing early repair. I have not seen such movements in patients whose nerves were repaired after three months. These movements were commented on by Sullivan in 1936 and by Fowler Jr. in 1939. It does not explain the failure of emotional control to reappear completely after voluntary control does. It may be of significance that the centers for emotional control, voluntary facial movements and associated movements are different. The centers for emotional control are located in the frontal lobe; the fibers are extrapyramidal, and the nerve is complex. The center for voluntary movement is in the precentral gyrus and the fibers are pyramidal; the centers for tonus are extrapyramidal in fibers from the globus pallidus to the facial nucleus. Certain surgical lesions which I have encountered indicate that associated movements are lost in lesions of the globus pallidus. The picture is confusing, and the true explanation has not yet been given. I do not believe the cause is peripheral. I agree with Dr. Voilé that the electrical response as an indication for surgical treatment is unreliable. Neither does Dr. Voilé refer to Bell's palsy.

Judgment is difficult when one is deciding whether to do a neurolysis or freeing of the nerve sheath by a longitudinal incision or, if the nerve trunk is hemorrhagic but continuous, a resection. The experience of the neurosurgeons at the University of California has been that better results have been obtained by resection. Dr. Voilé agrees with Duel and Ballance that a clean field is not necessary. I agree though I formerly held otherwise and I still prefer a clean operative field. Grafting with either single or cable grafts is successful, but end to end anastomosis where possible is preferable. The only patient in whom I would concede I saw emotional response had an end to end anastomosis, maintained by silk sutures. It is possible to maintain approximation without sutures if the trauma was caused by a gunshot, a stab or an automobile fender. The only patient I saw with an active frontalis muscle also had an end to end anastomosis. Suturing is done only through the nerve sheath, perhaps under magnification. I use primary closure and no dressing. Let it alone and don't look at it. There is nothing further to be done. In patients brought in two years after injury there is muscle sagging which makes even voluntary motion unsatisfactory. Our plastic surgery department uses fascial loops to shorten the muscles and improve their action. I recommend this for delayed repair.

DR. T. LAURANCE SAUNDERS, New York: Some time ago Dr. Tickle saw with me a patient with facial paralysis. The patient could almost close the eye. A distinguished neurologist gave his opinion that this indicated that the nerve had been only partially severed. That opinion was not shared by Dr. Tickle or myself, as Dr. Tickle could demonstrate in some cases closure of the eye with a completely severed nerve.

DR. PIERRE P. VOILÉ, Los Angeles: I doubt if th is much divergence of opinion on the points brou out, although they are debatable. I agree with Tickle that if after six weeks in traumatic cases faradic response is lost, decompression is justifia I did see bilateral Bell's palsy in a young girl in wh the faradic response was lost within seven days. I justified in recommending bilateral decompression was dissuaded by older men and the patient's reluctan Inside of six weeks her face returned to normal. R ance on the faradic response would have been an err

Recovery of the frontalis muscle is debatable. musculature is scant and probably regenerates rapid Youth is an advantage in any surgical procedure. think all agree on galvanic responses and that ne grafting in a suppurative field does give good resu As to the function in the upper eyelid, there may some connection with the third nerve. I cannot plain it.

The Use of Penicillin in Otitic Infections. P sented by DR. FRANCIS G. BLAKE, New Hav Conn.

During the last two and a half years' study of use of penicillin my associates and I have treated patients for otitic infections. Twenty-five had m toiditis, 5 had aseptic meningitis and 8 had sep meningitis as shown by positive cultures from the spi fluid. The types of organisms were as follows: B hemolytic streptococci were demonstrated in 22, 8 whom also had staphylococcic infection, which we b lieved to be secondary; 4 appeared to have prima staphylococcic infection, in 2 of whom there was mix infection; 7 were infected with some type of pneum coccus, and 1, with Hemophilus influenzae. In m of the patients the response to the sulfonamide co pounds had been unsatisfactory, so the penicillin w given from three to thirty-five days after the onse average, ten days or two weeks. (A slide was sho demonstrating the relative blood level of penicillin aft intravenous, after intramuscular and after subcutaneo injection.) The intravenous injection gives a high init concentration with a rapid fall; the intramuscular, 0. unit per cubic centimeter, maintained two hours; t subcutaneous injection has given no adequate conce tration at any time; so we use intramuscular injectio spaced at two hour intervals, with longer intervals be used as convalescence appears. For severe infection intravenous injection is given initially. Penicillin pe trates to the spinal fluid slowly; so for meningitis is also given intrathecally, intracisternally or into t ventricles, 5,000 to 10,000 units every twelve or twent four hours. It is excreted from the spinal fluid slow Its effectiveness is not impaired in the presence of p which is an advantage over sulfonamide drugs. Dosa depends on the susceptibility of the organism, the dur tion of the disease and the size and the age of t patient. Streptococcus haemolyticus is very sensitiv being inhibited by 0.005 to 0.01 unit; Pneumococc shows about the same sensitivity, and Staphylococc aureus requires three to six times as much. (A sli was shown illustrating the effect of treatment on oste myelitis.) Streptococci disappeared in twenty-fo hours; staphylococci required ten to twelve days. The were 4 patients with staphylococcus infections comp cated by aseptic meningitis. They all showed a respon to penicillin at first, but 1 patient had an epidur abscess that had to be drained; another in whom t disease failed to respond was found at operation the mastoid bone to have a heavy infection with influenzae, which is not susceptible to penicillin. The

re 7 patients with pneumococcic meningitis. One fected with type VII, a 12 month old infant, previ- ly treated with sulfonamide compounds, which cked the disease somewhat, received 5,000 units ramuscularly every four hours and 1,000 units daily intrathecal injection and made a satisfactory re- very. Six of the 7 patients, 3 of whom were infants, covered. One of the infants up to the present has own no mental development. One older patient, who tered moribund, died. One adult who, because of a rvical block, received penicillin first intracisternally d eventually in the lateral ventricles, recovered, but d six months later of arachnoiditis and paralysis.

In summary we may say that penicillin offers a great al in otitic infections, mastoiditis and their compli- tions and is superior in many instances to sulfonamide ugs. Much work needs to be done to define its efulness.

DISCUSSION

DR. T. LAURANCE SAUNDERS, New York: I should e to ask whether roentgen radiation was used before after in cases 119 and 101; also, how long penicillin ould be tried when mastoidectomy is indicated, and hether the use of penicillin is a substitute in any easure for surgical treatment; I am excluding, of urse, cases of meningitis.

DR. JACOB S. WENDEL: What types of pneumococcic infections were these?

DR. FRANCIS G. BLAKE: Practically all of these patients had roentgenologic examination, and their disease was diagnosed as mastoiditis. I cannot say with this limited experience when to resort to surgery in a patient treated with penicillin. I am sure penicillin therapy will not entirely replace surgical treatment. In case 119 it was the otologist who decided to operate. We persuaded him to await the result of penicillin treatment, and after forty-eight hours he decided that operation was unnecessary. I do not know how often that will happen, but I believe that fewer operations will be necessary in cases of hemolytic streptococcus infection and cases of pneumococcic infection. Less satisfactory results are expected in staphylococcic infections. In H. influenzae infection penicillin has no effect, as also in infection with Pneumococcus type 3, type 1 (1), type VII (1), type XIV and an undetermined type, and, I think, type XVI.

DR. BURT R. SHURLY, Detroit: Are there any contraindications?

DR. FRANCIS G. BLAKE, New Haven, Conn.: None that I know. There are no toxic reactions associated with its use.

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